Universitat Autònoma de Barcelona

2021/2022

Materials Science

Code: 102438
ECTS Credits: 6

Degree	Type	Year	Semester
2500897 Chemical Engineering	OB	3	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

Basic knowledge of English required.

Teachers

Ramón Yáñez López
Eva Maria Pellicer Vilà
Josep Gutiérrez Martínez

Prerequisites

This subject requires prior knowledge of chemistry and physics obtained during the first- and second-year degree in Chemical Engineering.

Objectives and Contextualisation

This subject approaches the students to the world of materials science. The internal structure of materials is correlated with their physical properties and finally with their applications. Special emphasis is laid on the assessment of mechanical properties, thermal treatments and the most characteristic transformation processes for each family of materials. Students should be able to properly apply the theory to problem solving, to make a critical analysis of the results, and to prepare and present cutting-edge topics in materials science in dedicated seminars.

Competences

- Apply relevant knowledge of the basic sciences, such as mathematics, chemistry, physics and biology, and the principles of economics, biochemistry, statistics and material science, to comprehend, describe and resolve typical chemical engineering problems.
- Apply scientific method to systems in which chemical, physical or biological transformations are produced both on a microscopic and macroscopic scale.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.

Learning Outcomes

1. Apply scientific method to the design of functional materials.
2. Apply the essential principles of crystallography to the interpretation of the phenomena of plastic deformation and diffusion.
3. Apply the existing relation between bond and structure in materials to the control of their electrical, magnetic and optical behaviour.
4. Control and modify the microstructures of metals and their alloys by means of phase reactions and thermal treatments, and relate them with the mechanical properties observed.
5. Develop independent learning strategies.
6. Develop scientific thinking.
7. Develop systemic thinking.
8. Distinguish the different types of ceramic materials by the applications for which they are used.
9. Generate innovative and competitive proposals in professional activity.
10. Identify the type and properties of the different polymers obtained and evaluate the effects that they produce, their physical and chemical properties, and the variation in their most typical parameters.
11. Identify the type of compound material in accordance with the dispersed phase present and calculate their mechanical properties.
12. Recognise the effect the fact that a material is nanostructured has on mechanical, optical and electromagnetic properties.

Content

1. Structure of solids. Crystalline structure of metals and ceramics. Structure of polymers

2. Composite materials and nanomaterials

3. Imperfections and diffusion in solids

4. Mechanical properties of the solids. Deformation and hardening mechanisms

5. Phase Diagrams. Phase Transformations

6. Synthesis, manufacture and processing of materials

7. Selection of materials

8. Electrical, magnetic and optical properties

Methodology

Teaching will run on-site. However, both the methodology and evaluation may undergo modifications depending on the restrictions imposed to on-site attendace by the health authorities. If virtual teaching is needed, TEAMS tool will be used.

Lectures: theory lessons aimed at showing key concepts of the subject. Powerpoint support will be used.

Practical lessons: in-class exercises directly related to the contents of the subject. Main problem-solving strategies will be discussed at class. Critical analysis of the results is to be pursued.

Seminars: The students, distributed in groups, will orally expose a timely topic within the field of materials science. The topic chosen must be previously agreed with the teacher. The length of the oral presentation will be approximately 10 minutes.

The self-work load encompasses the study of the fundamental concepts given in the lectures; preparation of in-class exercises; bibliographic search, preparation and presentation of a topic in seminars.

Students are expected to access the Virtual Campus on a regular basis since this will be the usual repository of ppt files used in the theoretical classes, solved problems, deliveries using the Moodle task, forums, etc.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
In-class exercises	15	0.6	1, 2, 3, 4, 8, 11, 10, 12
Lectures	30	1.2	1, 2, 3, 4, 8, 11, 10, 12
Seminars	5	0.2	1, 2, 3, 4, 8, 11, 10, 12
Type: Supervised			
Mentoring	5	0.2	
Type: Autonomous			
Bibliographic search	13	0.52	
Exercises outside class	30	1.2	1, 2, 3, 4, 8, 11, 10, 12
Self-study	40	1.6	1, 2, 3, 4, 8, 11, 10, 12

Assessment

The evaluation of the subject is online except for midterm and final exams, and will be performed in a continuous manner. In the event of the assessment activities a student has performed accounting for less than 2/3 of the subject's final mark, their work will be classified as "not assessable" on their transcript.

The final mark (NF) of the subject will be obtained from the following assessable activities:

70%: Mark of the two midterm exams [(P1 + P2) / 2] and / or of the final exam (F)

1st midterm exam (P1): topics 1 to 3 (35%).

2nd midterm exam (P2): topics 4 to 7 (35%).

(The date of the exam revision session will be notified through Campus Virtual in due time)

15%: Mark of the oral presentation (T)

15%: Mark of the assignments (PP)

Calculation of the final mark (NF) considering the midterm exams:

NF = 0.7 · [(P1 + P2) / 2] + 0.15 · T + 0.15 · PP

Calculation of the final mark (NF) considering the final exam (F):

NF = 0.7 · F + 0.15 · T + 0.15 · PP

* The final exam will consist of two separate exams corresponding to the contents of P1 and P2.

* A mark of 4.5 out of 10 points is required in the midterm exams for further averaging.

* If one of the midterm exams is scored less than 4.5 out of 10, student's knowledge will be reassessed (final exam). Recall that to be reassessed, the student must previously have submitted a minimum of two-thirds of the course-assessment items.

* If the mark obtained following reassessment is less than 5 (out of 10 points), the mark will not be weighted with the rest of assessable activities (T and PP).

* Students retaking the subject may, if they wish, do the final exam only and omit the midterm exams. They must, though, perform the oral presentation (T) and deliver the assignments (PP).

Unless formally misadvised by the healthauthorities, midterm and final exams will be done on-site.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Midterm exams or final exam	70%	11	0.44	1, 2, 3, 4, 8, 9, 11, 10, 12
Oral presentation	15%	0.5	0.02	6, 7, 5, 9
Written assignments	15%	0.5	0.02	1, 2, 3, 4, 5, 8, 11, 10, 12

Bibliography

- Introducción a la ciencia e ingeniería de los materiales; W.D. Callister 2ª ed. Ed. Limusa Wiley, 2009.
- Fundamentals of materials science and engineering, an integrated approach; W.D. Callister 3ª ed. Ed. John Wiley, 2008.
- Ciència dels materials; M.Cruells *et al.* Publicacions i edicions de la Universitat de Barcelona, 2007.
- Materiales para la Ingeniería; M.F. Ashby y D.R.H. Jones, vol 1 y 2, Editorial Reverté, 2009.
- Ciencia e Ingeniería de los Materiales; D.R. Askeland, Ed. Paraninfo, Madrid, 2001.
- Introducción a la Ciencia de Materiales para Ingenieros; J.F.Shackelford, 6ª ed., Prentice Hall, Madrid, 2005.
- Materiales: Estructura, propiedades y aplicaciones; J.A. de Saja *et a*l., Thompson, Madrid, 2005.
- Fundamentos de la Ciencia e Ingeniería de Materiales; W.F. Smith, McGraw-Hill, Madrid, 1993.
- Lecture notes: Campus Virtual UAB

Software

VESTA programme (free programme that allows visualizing 3D structures)

Wolfram Demonstration project: https://demonstrations.wolfram.com/