27218 - Materials Science

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	452 - Degree in Chemistry
ECTS	7.0
Year	4
Semester	Annual
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

The course of Materials Science, of the fourth year of the Chemistry Degree, is an annual and compulsory subject of 7 ECTS. This course provides Chemistry students with basic concepts related to Materials Science from the perspective of Chemistry.

1.2.Recommendations to take this course

It is recommended to have passed the courses of Inorganic Chemistry and Organic Chemistry. It is necessary to have a good knowledge of the basic concepts of both subjects and a continuous work of the subject.

1.3.Context and importance of this course in the degree

This course is part of the Advanced Module of the Chemistry degree in which the student puts into practice knowledge acquired in other courses of the basic and fundamental module, mainly of Inorganic and Organic Chemistry.

1.4.Activities and key dates

Period of presentation of works (seminars): second semester, will be announced well in advance

All the information about the calendar, schedules and tests of the global evaluation period is available in http://ciencias.unizar.es/web/horarios.do

2.Learning goals

2.1.Learning goals

* Describe the chemical nature and origin, basic properties and most important processing methods of the major types of materials.

* Appropriately relate the type of material, its preparation and possible processing, depending on the application and

property required.

* Critically evaluate the selection of materials for different technologies, according to properties and application conditions.

* Find, handle and organize information on Material Science related topics.

* Elaborate, present and defend topics related to Materials Science.

2.2.Importance of learning goals

The use of materials in different technological companies requires from the future graduate in Chemistry, of a minimum knowledge of structure, preparation and properties about the material. Research or innovation on new materials in different sectors such as energy, biomedicine, electronics or nanotechnology demands of professionals capable of joining their knowledge of Chemistry with those of Material Science, as well as the ability to work in interdisciplinary environments.

3.Aims of the course and competences

3.1.Aims of the course

The course and its expected results respond to the following approaches and objectives:

* That the student of the Degree in Chemistry recognizes the main types of materials, their properties and applications.

* That the student of the Degree in Chemistry relates the chemical structure of a material, the methods of preparation, processing and transformation with the properties and applications of the materials.

3.2.Competences

The student will be competent to

1. Apply the acquired chemical knowledge to defend and solve problems related to materials.

2. Establish a logical relationship between the chemical structure, the preparation and the properties of a material.

3. Predict and discern critically the most suitable material for basic applications and its main properties.

4. Understand the basic aspects of the processing and use of materials, as well as their possible environmental impact and recycling.

5. Establish an integral view of Materials Science and its relationship with other disciplines, its social and industrial implications, as well as to understand the new contributions of advanced materials.

6. Develop, present and defend basic works of material science.

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that has attained the expected learning outcomes by accomplishing the following assessment activities:

1. Ongoing assessment

This subject will have a course ongoing evaluation that includes the following activities: resolution of questions or practical cases, accomplishment of a tutored work and realization of two theoretical-practical tests.

A1. Resolution of questions and/or practical cases. Throughout the course there will be several short assessments based on questions and practical cases or related to the course activities. These tests will be announced in advance. From this assessment activity, a value R (rated from 0 to10) will be obtained.

A.2. Elaboration of a supervised work on a Materials Science topic: A written memory will be delivered that will also be presented and defended in the form of a seminar to the rest of the students and teachers. These seminars will be held on the second semester according to a presentation schedule that will be announced in advance. This work will be scored with an S value (rated from 0 to 10). This score will be maintained until September call.

A.3. Performance of two theoretical-practical exams during the academic year (prior to the global assessment period). The first one will be held along the January-February exam period (score T1), which will assess the topics covered in the first quarter, and the second at the end of the academic year (score T2), which will assess topics covered in the second quarter. Each of these exams will be graded from 0 to 10. These exams will yield a score T = 0.6 × T1 + 0.4 × T1.

The final mark of the course by ongoing assessment will be equal to:

Mark ongoing assessment = 0.05 × R + 0.2 × S + 0.75 × T

In order to pass the course, S and T must be equal or above to 4. Otherwise, the course will be considered failed (with a quantitative rating equal to the smaller of the S or T values).

2. Global assessment

Students who have not passed the ongoing assessment or just want to increase their marks, will be able to carry out an overall assessment in the June call that will consist of:

A.1. Presentation and defense of a topic of the course. This will be not necessary for those who have passed this activity in the ongoing assessment (S grade higher than 5, which is maintained until September call).

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A.2. Theoretical-practical exam of the totality of the topics covered during the course (TG note).

The course mark will be:

Mark Global assessment = 0.2 × S + 0.8 × TG

Those students who take the exam to upload their mark, they will maintain the best of the marks of continuous or global assessments.

In the event that the work has not been approved (grade S below 5), the subject will not be considered approved and the grade will be equal to S.

The global assessment in the September call will consist of:

A.1. Presentation and defense of a topic of the course for those who have not passed this activity in former calls (S less than 5)

A.2. Theoretical-practical exam of the totality of the topics covered during the course (TG note).

The overall test score will be:

The course mark will be:

Mark Global assessment = 0.2 × S + 0.8 × TG

In the event that the tutored work has been failed (grade S below 5), the subject will not be considered passed and the mark will be equal to S.

The policy and number of official calls academic year shall meet the terms of the Regulation of the Permanence in Master Studies and Regulation of the Learning Assessment. Also, the general design and scoring criteria of the assessment activities will fulfill the rules established at the Regulation of the Learning Assessment. According to the same regulations, Assessment general criteria, exam schedules and exam revisions will be announced.

Regulations can be found at: http://wzar.unizar.es/servicios/coord/norma/evalu/evalu.html

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course includes

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- Theory sessions with resolution of case study (5 ECTS)
- Tutored work with oral presentation (2ECTS)
- Tutorials for doubt resolution and follow-up of works

5.2.Learning tasks

The program is organized according to

- Theory sessions for the acquisition of basic knowledge of materials science that includes theoretical aspects, problem solving and case studies derived from the theoretical part. This type of activity is carried out in a single group classroom.
- Tutored workshops and seminars, including:

- Proposals of bibliographical research in practical cases and current topics related to Materials Science to work in small groups. Follow-up tutorials.

- Preparation of reports.

- Oral presentation and critical and participative discussion of the works.

5.3.Syllabus

The content of programmed activities of the course that will be assessed is the following:

1. Definition and classification of materials

2. Metals: Mechanical properties

Mechanical properties. Crystalline structures. Plastic deformation. Hardening of metals. Recovery and recrystallization of plastically deformed metals. Fracture and fatigue. Fluency and stress at break. Metals and alloys processing

3. Metals: Alloys

Production of iron and steel. Diagrams of condensed phases. Phase diagram iron-iron carbide. TTT diagrams. Thermal annealing of steel. Types of iron alloys. Aluminum-copper alloys. Other metal alloys. Refractory metals. Selection and use restrictions: corrosion

4. Ceramics and glasses.

Structure and properties. Raw materials. Ceramics processing. Thermal insulators and special coatings. Advanced ceramics. Glasses. Zeolites. Cements. Selection and use restrictions.

5. Polymers: Structure and properties

Polymerization and molecular mass. Chemical structure and stereochemistry. Amorphous and semicrystalline polymers. Mechanical and thermomechanical properties. Introduction to rheology. Other properties and testing of polymers.

6. Polymers: Processing and applications

Processing of polymers: Extrusion and molding. Additives in polymers. Natural and semisynthetic polymers. Thermoplastics. Thermosettings. Polymer foams, fibers and other polymeric derivatives. Selection and limits in the use of polymers. Sustainable production of polymers.

7. Composites

Classification. Matrices and reinforcements. Composites reinforced with particles. Fiber reinforcement. Influence of fiber-matrix interaction in mechanical properties. Other composites. Nanomaterials and its use for composites.

8. Electrical and Electronic Materials.

Conductivity and electrical resistivity. Dielectric and ferroelectric materials. Semiconductor materials and applications. Materials for the electronic industry. Materials for energy storage.

9. Magnetic Materials

Diamagnetism and paramagnetism. Ferromagnetism, antiferromagnetism and ferrimagnetism. Metals and soft and hard magnetic alloys. Permanent magnetic materials. Magnetic storage. Influence of temperature. superconductors

10. Optical Materials

Introduction. Optical fiber and applications. Photo and electroluminescent materials. Lasers. Photoconductors. Liquid crystals and displays.

11. Biomaterials: Types of materials and applications.

Metallic biomaterials. Bioceramics. Polymeric biomaterials and applications. Applications in therapy and diagnosis. Regenerative medicine. Nanobiomedicine.

12. New materials

13. Environmental impact on Materials Science

14. Characterization techniques for materials

Topics in new materials, environmental impact or characterization techniques of materials will be alternatively covered in seminars (by students).

5.4.Course planning and calendar

The schedules can be consulted in http://ciencias.unizar.es/web/horarios.do

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Supervised project presentations will be held during the second semester and dates will be duly announced.

5.5.Bibliography and recommended resources

BB	Askeland, Donald R.. Ciencia e ingeniería de los materiales / Donald R. Askeland . - Ed. española Madrid : Paraninfo, Thomson Learning, D.L. 2001
BB	Callister, William D., jr.. Ciencia e ingeniería de los materiales / William D. Callister, jr., David G. Rethwisch ; versión española por, Pere Molera Solà , Núria Salán Ballesteros . - 2ª ed. Barcelona [etc] : Reverté, 2016
BB	Callister, William D., jr.. Introducción a la ciencia e ingeniería de los materiales / William D. Callister, jr ; [versión española por Pere Molera Solà y Marc J. Anglada Gomila] . - [1ª] ed. en español, reimp. Barcelona [etc.] : Reverté, 2007 *[Obs. docente: Se incluye también otra edición más actual.]*
BB	Newell, James. Essentials of modern materials science and engineering / James Newell Hoboken : John Wiley & Sons, cop. 2009
BB	Shackelford, James F.. Introducción a la ciencia de materiales para ingenieros / James F. Shackelford ; traducción, adaptación y revisión técnica, Alfredo Güemes, Nuria Martín . - 6ª ed., reimp. Madrid [etc.] : Pearson Prentice Hall, 2008
BB	Smith, William F.. Fundamentos de la ciencia e ingeniería de materiales / William F.Smith ; traducción, Alicia Larena Pellejero . - 3ª ed. Madrid [etc.] : McGraw-Hill, D.L. 1998
BC	Carraher, Charles E., Jr.. Carraher's Polymer Chemistry. 9th ed. Taylor & Francis. 2013

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[Obs. docente: Consultar con profesorado del departamento de Química Orgánica.]

BC

Fernández Carrasquilla, Javier. Ciencia de materiales / Javier Fernández Carrasquilla, José María Lasheras Esteban . - 2a. ed. San Sebastian : Editorial Donostiarra, D.L. 2001

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Polímeros / Javier Areizaga...[et. al.] Madrid : Síntesis , D.L. 2002

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Smart, Lesley. Solid state chemistry : an introduction / Lesley E. Smart, Elaine A. Moore . - 3rd ed. Boca Raton [etc.] : Taylor & Francis, cop. 2005