Advanced Metallic Materials

Academic Year: (2022 / 2023) **Review date: 29-06-2021**

Department assigned to the subject: Department of Materials Science and Engineering and Chemical Engineering

Coordinating teacher: MARTINEZ CASANOVA, MIGUEL ANGEL

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Chemical Basis of Engineering
Science and Engineering of Materials

OBJECTIVES

COMPETENCES
CB6, Acquire and understand concepts that provide the foundation or opportunity to be original on the development and/or application of ideas, often in a research context.
CB7, Students will be able to apply the acquired knowledge and skills on problem resolution in new or hardly known environments in the context of wide (or multidisciplinary) contexts related to the area under study.
CB8, Students will be able to integrate knowledge to face the complexity of making assessments based on limited or incomplete information, but considering the ethical and social responsibilities associated to the application of their knowledge and assessments.
CB9, Students will be able to communicate their conclusions and the knowledge and reasons that support them to both specialized and wide public in a clear and unambiguous manner.
CG1, Understand the challenges associated to Materials Science and Engineering in an industrial and research environment.
CG2, Know the adequate disciplines to work in a materials¿ lab and optimize getting results.
CG3, Develop team working skills in a research environment.
CG4, Develop skills to apply the acquired knowledge to the research and development of new materials or in technologies for their processing in strategic sectors.
CG5, Combine the interest on innovation and process optimization, with the need of doing so in an environmentally friendly manner.
CG6, Acquire the required skills to defend a research project and its results.
CG7, Develop creative strategies for decision making to solve problems associated with materials, their design, processing and behaviour.
CE1, Discover the latest tendencies in development of new materials and be aware of their potential advantages with respect to more traditional materials.
CE2, Be able to design new ways of optimizing the properties of different materials for specific applications, through the modification of their structure and composition.
CE3, Know processing systems and advanced synthesis that allow to obtain materials with improved properties.
CE4, Acquire ability to optimize a processing technology for specific applications and problems.
CE5 Be able to develop creative strategies and decision-making facing problems related to materials, manufacturing and behavior.
CE5, Know in detail the most used in research characterization techniques for materials and acquire the skills to autonomously use the associated instrumentation.
CE6, Interpret, discuss and elaborate conclusions from experimental data obtained from complex characterization techniques, usual in Materials Science and Engineering.
CE7, Know and understand the environmental effect of materials during their life cycle, developing new materials and processing techniques base don sustainability criteria.
CE8 Know the environmental impact of materials during the entire their life cycle, and how to minimize it
CE9, Consolidate specific research skills in Materials Science and Engineering.
CE10, Acquire knowledge and useful scientific and technical skills to solve specific problems associated with the work in a research laboratory in the field of material development and characterization.

LEARNING RESULTS
Overcoming this matter ensures that the student will be able to:

- Apply new manufacturing technologies for specific designs.
- Select alloys and design microstructures necessary to meet certain requirements
- Identify the most appropriate techniques for recycling metals.

DESCRIPTION OF CONTENTS: PROGRAMME

Topics common to the courses:
The topics of this matter complement the basic knowledge in Materials Science and Engineering, that students must have acquired during their university training, deepening essentially on the following topics:
- Structure and properties of advanced materials.
- Advanced materials processing techniques.
- Possible advantages and disadvantages of advanced materials versus traditional materials

Specific topics of advanced metallic materials:
1) Innovation processes for the obtaining of metals and metal alloys: Thermodynamic and kinetic fundamentals of metallurgical processes. Processes innovation as alternatives to the current processes. Recycling of strategic and pollutants metals.
2) Design of alloys by applying phase diagrams: Liquid-solid reactions. Solidification process Solid state reactions. Diffusion kinetics. Time-temperature-transformation diagrams. Characteristics of metallic materials for structural or functional applications.
3) Innovations in ferrous and non-ferrous alloys: Light alloys. Ferrous alloys. Intermetallics. Superalloys. Metal glasses. Porous materials.
4) Joining technologies: Welding processes. Non-fusion welding processes. Welding metallurgy. Effects of the gases. Defectology.
5) Advanced processing of metallic materials: Additive manufacturing.

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES
AF1, Theoretical-practical classes.
AF2, Lab practices
AF3, Tutorials
AF4, Work in groups
AF5, Individual work from the student
AF6, Visits to companies or research labs related to the subject, our from Universidad Carlos III de Madrid

METHODOLOGIES
MD1, Explanations in class, so the professor develops main concepts of the subject, practical examples or problems
MD3, Practical resolution of examples, problems or exercise, by the student (alone or in groups)
MD4, Explanation and discussion in class, under professor supervision, of issues related to the subject
MD5, Obtaining experimental results in the lab, using research equipments and techniques, under professor supervision
MD6, Elaborating Works and reports, alone or in groups

ASSESSMENT SYSTEM

ASSESSMENT
Participate in classes and labs, demonstrated critical analysis on considered matter (SE1): 5%
Carry out and/or exhibition of works, exercises or reports, made alone or in groups, during the course (SE2): 20%
Carry out lab practices, elaborate, present and discuss reports or questions, related to used techniques and obtained experimental results. (SE3): 10%
Final exam of the subject, to be done individually, written or oral (SE4): 65%

% end-of-term-examination:	65
% of continuous assessment (assigments, laboratory, practicals…):	35

BASIC BIBLIOGRAPHY

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- J.F. Lancaster. Metallurgy of welding., Chapman & Hall , 1994

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- A. Ballester, L.F. Berdeja, J. Sancho Metalurgia extractiva. Vol. 1 y 2, Sintesis, 2000
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- D.A. PORTER, K.E. EASTERLING Phase transformations in metals and alloys, Chapman & Hall, 1992.
- G. Lütjering, J. Williams Titanium, Springer, 2003
- J.J. Moore Chemical metallurgy, Butterworth Hesnemann, 1994
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- M.J. Donachie, S.J. Donachie Superalloys: a technical guide, ASM International, 2002.
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