Materials science and engineering

Academic Year: (2019 / 2020) **Review date: 02/07/2019 10:48:53**

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

Coordinating teacher: TSIPAS , SOPHIA ALEXANDRA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

OBJECTIVES

CB1. Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
CB2. Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
CB4. Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
CB5. Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
CG1. Analyze and synthesize basic problems related to physics and engineering, solve them and communicate them efficiently.
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CE7. Understand and apply the principles of basic knowledge of general and inorganic chemistry and its use in engineering.
CE9. Understand and handle the fundamentals of materials science, technology and chemistry, as well as the relationship between microstructure, synthesis or processing and the properties of materials.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.
RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them;
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking;
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study;
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to Materials Science and Engineering. Concepts of Materials Science and Engineering. Families of Materials. Properties, applications
and selection of materials. Relationship between bond, structure and properties in materials.
2. Crystalline structures: Unit cells and Crystal Systems. Lattice, Bravais Lattice. Crystalline structures (metallic and ceramics). Atomic positions, directions
and crystallographic planes. Lineal, planar and volumetric densities in crystals
3. Crystal Defects, Non-Stoichiometry and Solid Solutions. Crystalline imperfections: Extended Defects. Dislocations and Mechanical Properties of Solids.
Non Stochiometry. Solid Solutions.
4.- Diffusion in solids. Fick¿s Laws of Diffusion: First and second Law. Industrial Applications of diffusion: Carburizing and Nitriding Processes. Processing
of Microelectropnic Circuits
5.- Phase Diagrams.- Phase diagrams: Basic concepts. One- and two- component diagrams.
- Systems with total and partial solubility. Solid-state precipitation. Invariant reactions. - Intermetallics. Congruent and incongruent melting. Applications
of Phase Diagrams in the Industry.
6. Mechanical properties: Definition of mechanical properties. Stress-deformation concepts. Elastic and plastic deformations. Slipping systems. Hardening.
7. Electrical properties: Electric properties. Metallic and non-metallic conductors. Semiconductors. Isolating and dielectric materials. Ferroelectrics Ionic
conductors.
8. Magnetic Properties: Classification of magnetism. Effect of Temperature. Ferromagnetics domains. Magnetic Materials, Their Structures and Properties.
Applications: Structure¿Property Relations
9. Metallic materials: Solidification process. Engineering alloys. - Steels. Transformations under equilibrium conditions. Diffusion-less transformation.
10.- Ceramic Materials: Structure and bond in ceramics. Structural and Functional Ceramics. Structure of silicates. Thermal properties of Ceramics. Mechanical
properties of Ceramics. Weibull Modulus. Amorphous materials. Glass transition temperature. Glasses. Properties of ceramics. Applications of
ceramics.
11. Polymer materials I: General concepts. Polymers structure. Classification. Polymerization reactions. Thermoplastics. Thermosetting Plastics. Elastomers.
Mechanical Properties of Polymers.
12. Composite materials. Classification of composite materials. Polymer matrix composite materials. Fibers. Manufacturing of Composites.
13.- Materials Selection Case Studies.

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

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ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.
SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.