Materials science and engineering

Academic Year: (2019 / 2020) **Review date: 24/04/2020 16:40:08**

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

Coordinating teacher: ALVAREDO OLMOS, PAULA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

OBJECTIVES

1. knowledge and understanding of key aspects of materials science, technology and chemistry.
2. the ability to apply their knowledge and understanding to identify, formulate and solve problems of materials science, technology and chemistry using established methods;
3. the ability to design and conduct appropriate experiments of materials science, technology and chemistry, interpret the data and draw conclusions;
4. workshop and laboratory skills in materials science, technology and chemistry.
5. the ability to select and use appropriate equipment, tools and methods to solve problems of materials science, technology and chemistry;
6. the ability to combine theory and practice to solve problems of materials science, technology and chemistry;
7. an understanding of applicable techniques and methods in materials science, technology and chemistry, and of their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

INTRODUCTION TO THE COURSE. BONDS IN SOLIDS.
Description of the course organization. Evaluation system. Recommended bibliography. Concepts of Materials Science and Engineering. Families of materials. Properties, applications and selection of materials. Bond in solids. Relationship between bond structure and properties in materials.

CRYSTALLINE STRUCTURE IN SOLIDS.
Unt cell description. Crystalline systems, main metallic structures and interstitial positions, notation of atomic positions, directions and planes. Calculation of linear, planar and volumetric density.
Exercises of defects in crystalline structures.

MASS TRANSPORT. DIFFUSION.
Description of diffusion mechanisms in solids. Study of Fick´s laws. Influence of temperature.
Problems of Mass transport. Diffusion.

EQUILIBRIUM PHASE DIAGRAMS.
Definition of phase diagram. Tipes of phase diagrams related with solubility. Invariant reactions.
Calculations in phase diagrams.
Problems of Equilibrium phase diagrams.

MECHANICAL PROPERTIES
Tipes of mechanical test. Definition of elastic and plastic deformation. Hardening mechanisms. Nominal stress-strain curve. True stress-strain curve. Methods to measure hardness in MSE.
Problems of Mechanical properties.

ELECTRICAL PROPERTIES.
Classification of materials: conductor, semiconductor and insulator. Bands theory. Aplications. Materials selection exercises.

METALLIC MATERIALS

Classification of metallic materials. Description of ferrous and non ferrous metals. Metallic materials obtention. Study of solidification process.
Steel: Equilibrium transformations.
Study of Fe-C phase diagram. Phases microconstituents and invariant reactions. Exercises of Fe-C phase diagram.
Steel: Non-Equilibrium transformations.
Study of non-equilibrium phases. TTT diagram. Description of the thermal treatments and its relationship with the final properties of the steel. Hardenability concept. Jominy test.
Problems of Steel: Non-Equilibrium transformations.

CERAMIC MATERIALS.
Ceramic materials classification. Study of main ceramic materials and their properties. Obtention methods. Aplications.
Problems of Ceramic materials.

POLYMER MATERIALS.
Polymer materials classification. Calculation of molecular weight. Study of polymer characteristics: crystallinity and glass transition temperature. Tipes of polymer related with thermal behavior. Obtention methods. Aplications.
Mechanical properties of polymer materials. Problems of Polymer materials.
Description of mechanicla behavior of polymers and the relation with their structure. Problems & exercises

COMPOSITE MATERIALS.
Classification of composite materials related with their composition and structure of matrix and reinforcemnt. Calculation of the mechanical properties. Manufacturing methods.
Problems of Composite materials.

LABORATORY SESSIONS

1. Crystalline structures.
Study of ain crystalline structures in metals. Searching of interstitial positions. Meatls determination by Xray Diffraction. Bragg´s law.
2. Cold working in metals.
Study of varition of hardness and electriacal properties after the cold working of a brass sample. Study of the properties after annealing.
3. Steel thermal treatments
Microstructural study of steel after thermal treatment. Toughness determination by charpy test at different temperature. Calculation of brittle-ductile transition temperature.
4. Polymer characterization.
Polymer determinationby study of thermal behavior, Belstein test, density measurement. Polymer classification: thermoplastic and thermosetting.

LEARNING ACTIVITIES AND METHODOLOGY

Masterly classes, classes to solve doubts in reduced groups, student presentations, individual tutorship and personal work of the student; oriented to acquire theoretical knowledge (3 ECTS credits).
Laboratory classes, classes for solving problems in reduced groups; individual tutorship and personal work of the student; oriented to acquire practical knowledge related to subject program (3 ECTS credits).

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ASSESSMENT SYSTEM

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

The assistance to the laboratory sessions is MANDATORY. The entrance to the laboratory is enabled once the student has watched the general security video and the specific video for materials lab and answered both tests correctly. THE STUDENT CAN NOT ENTER THE LABORATORY IF HE/SHE HAS NOT ANSWERED THE TESTS. THE NON-ASSISTANCE TO THE LABORATORY WITHOUT JUSTIFIED CAUSE IMPLIES SUSPENDING THE CONTINUOUS EVALUATION.

40% of the continuous assessment will be given by:

30%: Three mid-term exams, each with an calification of 10%, which will be done during class time.
10%: Lab work done outside of class time. The final note of the laboratory will be given by the behavior in the laboratory, realization of lab work and realization of a questionnaire at the end of each session.
60% of the continous assessment will be given by the score of the final exam.
For continuous evaluation a minimum score of 4 is required on the final exam.

Normative continuous assessment:
https://www.uc3m.es/ss/Satellite/UC3MInstitucional/en/ListadoNormativas/1371206706530/Estudios_de_Grado

BASIC BIBLIOGRAPHY

- ASHBY MF, JONES DRH. Materiales para Ingeniería 1. Introducción a las propiedades, las aplicaciones y el diseño¿., Reverté. 2008.

- ASKELAND DR. "Ciencia e Ingeniería de los Materiales",, International Thomson, 4ª Edición, Madrid, 2001.

- CALLISTER WD. "Ciencia e Ingeniería de los Materiales". Vol. I,, Ed Reverté, 3ª Edición, Barcelona, 1995.

- MANGONON PL. ¿Ciencia de Materiales. Selección y Diseño¿., Prentice Hall, 1ª Edición, Méjico, 2001.

- SHACKELFORD JF. "Introducción a la Ciencia de Materiales para ingenieros",, Prentice Hall, 4ª Edición, Madrid, 1998.

- SMITH WF. "Fundamentos de la Ciencia e Ingeniería de Materiales",, McGraw-Hill, 3ª Edición, Madrid, 2003.