Joining Technologies: Welding and Adhesives

Academic Year: (2019 / 2020) **Review date: 21-04-2020**

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

Coordinating teacher: MARTINEZ CASANOVA, MIGUEL ANGEL

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Chemical Basis of Engineering
Materials Science and Engineering
Industrial Materials

OBJECTIVES

By the end of this content area, students will be able to have:
1. a systematic understanding of the key aspects and concepts of materials science and engineering
2. coherent knowledge of materials science and engineering including some at the forefront of the branch in mechanical engineering;
3. awareness of the wider multidisciplinary context of engineering.
4. the ability to apply their knowledge and understanding to identify, formulate and solve problems of materials science and engineering using established methods;
5. the ability to design and conduct appropriate experiments of materials science and engineering, interpret the data and draw conclusions;
6. workshop and laboratory skills in materials science and engineering.
7. demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice;

DESCRIPTION OF CONTENTS: PROGRAMME

Topic 1. Non-destructive tests. Visual inspection. Acoustic inspection. Penetrating liquids. Magnetic particles. Induction currents: Eddy currents. X-ray and scintigraphy. Ultrasound Active thermography. Holographic interferometry. Test selection.
Topic 2. Welding technology. Materials to be welded Fe-C system. Thermal treatments of steels. Aluminum base alloys hardened by maturation or deformation. Types of welding. Welding with fusion. Welding without fusion. Heat flux. Mass flow. Gases.
Topic 3. Welding metallurgy. Solidification of the fusion bath. Transformations in the Fe-C system. Maturing hardened alloys. Alloys hardened by deformation. Galvanized steel. Defectology.
Topic 4. Introduction to adhesives. Basic concepts of adhesion. Formation of the adhesive bond. Design criteria and examples. Comparison of joining techniques. The interface. Adhesion models (mechanical, chemical bond, electrical, diffusion). Effect of weak layers of preferential breakage.
Topic 5. Surface treatments. Surfaces characteristics: Roughness. Influencing factors. Pretreatments: Abrasion and cleaning. Chemical treatments. Physical treatments. Surface analysis techniques.
Topic 6. Mechanical behavior and degradation. Mechanical properties of polymer materials. Mechanical requests for adhesive bonding. Analysis of single lap joints. Mechanics of fracture. Degradation Effect of temperature, humidity and solvents. Mechanical and thermal fatigue. Combined effects
Topic 7. Types of adhesives. Polymerization process. Types of adhesives. Dosing systems. Rigid adhesives: Epoxy, Cyanoacrylates, Anaerobics and Acrylics. Flexible adhesives: Polysulphides, Silicones, Polyurethanes and Modified Silanes. Prepolymerized adhesives: in liquid phase, adhesive tapes and hot melts.

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LEARNING ACTIVITIES AND METHODOLOGY

Master classes, personal and group work, student presentations; oriented to the acquisition of theoretical knowledge.
- The course consists of lectures and practical classes in the classroom that will include the exhibition of work on topics related to asigntura
- The student may apply for individual tutoring with his/her teachers prior appointment.
- -All teaching materials (class transparencies, worksheets, practice scripts, and additional material) will be available through the Global Classroom 2 platform in advance.

ASSESSMENT SYSTEM

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

- The student's final grade will be the weighted average of the continuous assessment of the student's work throughout the course, the final exam grade and the grade of the papers (oral presentation and written work).
- The continuous evaluation throughout the course takes on a particular importance in the subject and represents up to 40% of the final grade. The students will have to prepare written documentation and will make the oral presentation of at least one work on the thematics or the contents of the subject.
- In the regular final exam, the student is evaluated of the remaining 60% of the grade, being necessary to pass this exam with a grade equal to or greater than 4 to be weighted with the rest of the continuous assessment.
- The remaining 40% corresponds to the continuous evaluation. The pass is achieved by reaching a global final grade of 5

Extraordinary exam.
It will be 60% of the mark if the continuous evaluation is taken into account
It will be 100% of the mark if continuous evaluation is not taken into account

BASIC BIBLIOGRAPHY

- A. Pizzi, K.L. Mittal Handbook of Adhesive Technology, Marcel Dekker, 2003

- A.J. Kinloch Adhesion and Adhesives: Science and Technology, Chapman & Hall, 1987

- A.J. Kinloch Durability of Structural Adhesives, Elsevier, 1983

- D. Brandon, W.D. Kaplan Joining Processes. An Introduction, John Wiley & Sons, 1977

- D.E. Packham Handbook of Adhesion, Longman Sci&Tech, 1992

- H. Granjon Bases de la Metalurgia de la Soldadura, Eyrolles, 1989

- L.F.M. Lucas, A. Öchsner, R.D. Adams Handbook of Adhesion vol 1 and 2, Springer, 2011

- R.D. Adams, W.C. Wake Structural Adhesive Joints in Engineering, Elsevier, 1984

- Varios ASM Handbook vol. 6. Welding, Brazing and Soldering, ASM, 1993

- Varios ASM Handbook vol. 17. Nondestructive Evaluation, ASM, 1989

- Varios Engineered Materials Handbook vol 3. Adhesives and Sealants, ASM, 1990

- Ø. Grong Metallurgical Modelling of Welding, The Institute of Materials, 1997