

**COURSE DATA****Data Subject**

<b>Code</b>	34758
<b>Name</b>	Materials science II
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	6.0
<b>Academic year</b>	2020 - 2021

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
1401 - Degree in Chemical Engineering	School of Engineering	2	Second term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1401 - Degree in Chemical Engineering	11 - Equipment materials and design	Obligatory

**Coordination**

<b>Name</b>	<b>Department</b>
LLOPIS ALONSO, FRANCISCO	245 - Chemical Engineering

**SUMMARY**

The goal of this course is that the students acquire the basic knowledge of Science of Materials for the study, design and / or operation of the most common equipment in the chemical industry.

The course contents are: Chemical technology, synthesis and processing of materials. Properties and applications of metallic materials, polymers, ceramics and composites. Corrosion. Behavior and control of materials. Degradation and failure of materials. Inspection and testing. Elasticity and strength of materials.

The subject of Materials Science II is taught in the second degree course in Chemical Engineering during the second quarter. In the curriculum of the Valencia University has a total of 6 ECTS. Included in Materials and Equipment design.

The theory classes will be taught in Spanish and practical classes as stated in the course information available on the website of the degree.



## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

Student required some prior knowledge in:

Physics  
Chemistry  
Mathematics  
Materials Science I  
Basic level of Castellano.

## OUTCOMES

### 1401 - Degree in Chemical Engineering

- G3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- G6 - Ability to deal with specifications, regulations and mandatory standards.
- G8 - Ability to apply the principles and methods of quality control.
- G10 - Ability to work in a multilingual and multidisciplinary environment.
- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.
- R3 - Knowledge of materials science, technology and chemistry fundamentals. Understand the relationship between microstructure, synthesis or processing and the properties of materials.
- R8 - Knowledge and use of the fundamentals of the strength of materials.

## LEARNING OUTCOMES

### Learning results

- Know the properties (chemical, mechanical, thermal and electrical) and industrial applications of different types of materials: ceramic, metal, glass, polymers, and composites and their degradation processes, life and prevention of use. (Outcomes G3, R3)
- Selecting the optimum material for a particular application and justify their choice. (Outcomes G4, G6, R3, R8)
- Determine the mechanical properties of materials and types of tests are used. (Outcomes G4, G6, G8, G11, R3, R8)
- Understanding the mechanisms of corrosion and fracture, and how to avoid them. (Outcomes G4,



G6, G8, R3, R8)

- Know and apply regulations and industry codes in the mechanical design of equipment and simple structural elements. (Outcomes G10, G11, R3, R8)
- Know and apply principles of safety in the design of mechanical equipment and structural elements simple. (Outcomes G6, G8, G11, R3, R8)
- Be able to analyze the predictable failures in industrial equipment. (Outcomes G4, G6, R3, R8)
- Prepare written reports. (Outcomes G4, G10, G11)
- Make designs individually and in groups. (Outcomes G6, G8, G11, R3, R8)

After completing the course, students will be able to:

- Know the properties (chemical, mechanical, thermal and electrical) and industrial applications of different types of materials: ceramic, metal, glass, polymers, and composites.
- Determine the mechanical properties of materials and types of tests used.
- Understanding the mechanisms of corrosion and degradation processes and learn methods of prevention.
- Know the types of fracture, and how to avoid them.
- Understand the fundamentals of elasticity and strength of materials and their application in industrial equipment.
- Know the types, fundamentals and functionality of equipment and common elements in the chemical industry.
- Selecting the optimum material for a particular application and justify their choice.
- Select the equipment and / or appropriate item for a particular purpose and justify their choice.
- Know and apply regulations and industry codes in the mechanical design of equipment and simple structural elements.
- Know and apply principles of safety in the design of mechanical equipment and structural elements simple.
- Be able to analyze the predictable failures in industrial.
- Prepare written reports.
- Make designs individually and in groups.

In addition to the specific objectives mentioned above, the course will encourage the development of several social and technical skills, among which include:

- Capacity for analysis and synthesis.
- Ability to argue from rational and logical criteria.
- Ability to communicate in a properly and organized manner.
- Ability to develop a problem in a systematic and organized manner.
- Ability to work and distribute the personal time.
- Ability to work in groups.



## DESCRIPTION OF CONTENTS

### 1. MATERIALS SCIENCE AND ENGINEERING

Materials Science and Engineering. Materials Classification. Materials in Chemical Engineering. New Materials.

### 2. ELASTICITY AND PLASTICITY OF MATERIALS

Concepts of stress and strain. Elastic deformation. Deformation in shear or torsion. Plastic Deformation. Yield strength. Tensile strength. Ductility. Resilience. Hardness. True stress. Security factors.

### 3. MECHANICAL RESISTANCE OF MATERIALS

Failure. Fundamentals of Fracture. Ductile or brittle fracture. Fracture toughness. Impact fracture testing. Fatigue. Cyclic stress. Creep. Nondestructive assays. Fractography.

### 4. PROPERTIES AND APPLICATIONS OF METALLIC MATERIALS

Mechanical properties of metals and alloys, industrial application. Identification Nomenclature. Thermal processing of metal alloys. Dislocations and strengthening mechanism.

### 5. PROPERTIES AND APPLICATIONS OF CERAMICS.

Mechanical properties of traditional and engineering ceramics. Brittle Fracture. Stress-strain behaviour. Influence of porosity. Glasses. Viscous deformation.

### 6. PROPERTIES AND APPLICATIONS OF POLYMERS.

Polymer classification. Mechanical Behavior of Polymers. Viscoelasticity. Fracture and Fatigue of Polymers.

### 7. PROPERTIES AND APPLICATIONS OF COMPOSITES.

Mechanical Characteristics of Composites. Particle reinforced composites. Fiber reinforced composites. Structural composites.

### 8. INTRODUCTION TO CORROSION AND DEGRADATION OF MATERIALS

Introduction to Corrosion of materials. Economic aspects of corrosion. General mechanisms in the corrosion of metals. Ceramic corrosion. Polymers degradation.

**9. BASIS OF METALLIC CORROSION, ELECTROCHEMICAL CONSIDERATIONS**

Electrochemical Aspects of Corrosion. Thermodynamic Aspects in the metals corrosion. Corrosion rate. Polarization. Passivity. Galvanic Series. Types of electrochemical corrosion.

**10. HIGH TEMPERATURE CORROSION OF METALS**

Thermodynamic aspects of hot corrosion. Influence of the physico - chemical properties of the oxide film. Kinetic aspects. Influence of reticular characteristics of oxide film.

**11. DEGRADATION AND FAILURE OF MATERIALS**

Electrochemical corrosion due to galvanic atmospheric or located factors. Combined action of mechanical and corrosive factors. Corrosion Prevention. Practical considerations in the material selection.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	40,00	100
Classroom practices	20,00	100
Development of individual work	10,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	30,00	0
Preparation of practical classes and problem	30,00	0
<b>TOTAL</b>	<b>150,00</b>	

**TEACHING METHODOLOGY**

The development of the course is structured around the theory classes, practical activities and reading research papers, through a scheduled plan that will be given previously to the students. Some of these activities will be evaluated and will contribute to the final mark.

In the theory classes lecture model will be used to explain the most complex or difficult notions and always during periods of less than 30 minutes. Many of the theoretical concepts will be prepared by students working with the material provided to them, always doing an exercise related to the studied material. The main competences worked with these activities will be G3, G4, G6, G10, R3 i R8.

Problems will be developed in practical class sessions following two models. Some problems will be solved by the teacher so that students find out the way to address them, while others will be solved by students, individually or in groups under the supervision of the teacher. After the work, the problems will be collected, analyzed and corrected by the teacher or the students. The main competences worked with these activities will be G3, G6, G8, G10, G11, R3 i R8.





The proposed work for the students will be of several types: Questions or short exercises, problems similar in complexity to those of exams and self-correcting tests performed in the e-learning platform. The main competences worked with these activities will be G3, G4, G6, G10, R3 i R8.

## EVALUATION

The assessment of student learning at the first call will take place following two ways:

Type A: The assessment with this model is based on a continuous assessment taking account the works (tests and proposed problems) and two objective exams.

By assessing the activities of students (questionnaires and problems) and the objective exams. To be eligible for evaluation with the mode A, the student must have attended 80% of classes and obtained in the proposed activities an average score greater than or equal to 5 (over 10). Once these two requirements have been achieved, the final mark will be obtained as the greater of:

- the weight between the average mark of the objective exams (75%) and the average score of the activities (25%), provided that the average mark of the objective exams is equal to or greater than 4,5 (over 10).
- the average mark of the objective exams.

Type B: The assessment of the course with this model will be realized through an exam of all contents of the course in the official date.

The note with this method is obtained by weighting of the final exam (80%) and the average score of the activities (20%), provided that the mark of the final exam is equal to or greater than 4,5 (over 10).

The subject is considered overcome when the mark obtained is equal to or greater than 5 (over 10). If a minimum mark of 4,5 (out of 10) is not gotten in the exam, the final mark will be the grade obtained in the exam.

The exams will have theoretical and practical questions and problems. Achievement of competences G3, G6, G8, G10, G11, R3 i R8 will be evaluated.

In the second call, the evaluation will be conducted by Type B.

Anyhow, the evaluation system will be based on the guides stated in the “Reglament d’Avaluació i Qualificació de la Universitat de València per a Graus i Màsters” (<http://links.uv.es/7S40pjF>).



## REFERENCES

### Basic

- Introducción a la Ciencia e Ingeniería de los Materiales. W.D. Callister. Ed. Reverté. 1995.
- Fundamentos de la Ciencia e Ingeniería de Materiales. W.F. Smith. Ed. McGrawHill. 2014. ebook en UV
- Introducción a la Ciencia de los Materiales para ingenieros. J.F. Shackelford, Ed. Prentice Hall, 2010. ebook en UV
- Ciencia de Materiales. Selección y Diseño. P.L. Mangonon, Ed. Prentice Hall. 2001.
- Ciencia e Ingeniería de los Materiales. D.R. Askeland, Ed. Paraninfo (Thomson Learning). 2001.
- Corrosión y degradación de materiales. E. Otero Huerta. Ed. Síntesis (Madrid) 1997.

### Additional

- Metal fatigue in engineering. H.O. Fuchs, R.I. Stephens. Ed. John Wiley & Sons (New York) 1980.
- Fractura de materiales. M.J. Anglada y otros. Ed. UPC (Barcelona) 2002.
- Diseño y Análisis de Materiales Compuestos. S.W. Tsai, A. Miravete. Ed. Reverté. 1988.
- Teoría y Práctica de la Lucha contra la Corrosión. Coord. J.A. González Fernández. Ed. C.S.I.C. (Madrid) 1984.
- Corrosión y Protección Metálica. Coord. M.C. Andrade, S.Feliu. Ed. C.S.I.C. (Madrid) 1991.
- Corrosion Engineering. M.S. Fontana. Ed. McGraw-Hill. 3ed. 1988.
- Corrosión y Protección. L. Bilurbina, F. Liesa, J.I. Iribarren. Ed. UPC (Barcelona) 2003.
- Materials Selection for the Chemical Process Industries. C.P. Dillon. Ed. McGraw-Hill. 1991.
- Materiales de Ingeniería y sus Aplicaciones. R.A. Flinn, P.K. Trojan. Ed. McGraw-Hill. 1990.
- Materials Selection in Mechanical Design. M.F. Ashby. Ed. Butterworth & Heinemann. 2005. ebook en UV
- Selection and Use of Engineering Materials. J.A. Charles, F.A.A. Crane, J.A.G. Furness. Ed. Butterworth & Heinemann. 1997. ebook en UV

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

### Contents



The contents initially established in the Course Guide are maintained.

### **Workload and planning of teaching**

#### *Workload:*

The activities described in the Course Guide with their time dedication are maintained.

#### *Planning of teaching:*

The resources used in the theoretical and practical sessions allow to continue with the planning of teaching both in days and in scheduled, both of if is in-person class or not.

### **Teaching methodology**

The development of the subject is articulated as has been established in the teaching model of the degree for the second semester ([https://www.uv.es/etsedoc/Web/Modelo%20Docente\\_GIQ\\_2C.pdf](https://www.uv.es/etsedoc/Web/Modelo%20Docente_GIQ_2C.pdf)).

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes, these will be replaced by non-person sessions following the established timetable.

### **Evaluation**

The evaluation system described in the Course Guide in which the activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for sanitary reasons that affect the development of any face-to-face evaluable activity, it will be replaced by a test/activity of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the course will remain unchanged, as established in this guide.

### **References**

The recommended references in the Course Guide are maintained, since they are available. In addition, it will be complemented with notes, slides and problems uploaded to the Virtual Classroom.