PERSONA CIÈNCIA EMPRESA
Universitat Ramon Llull

# TITLE OF COURSE: FUNDAMENTALS OF SCIENCE AND TECHNOLOGY OF MATERIALS

**MATTER**: Fundamentals of Science and Technology of Materials
**MODULE**: Common to Industry Branch
**PROGRAM TITLE**: Degree on Industrial Technologies Engineering

## GENERAL CHARACTERISTICS*

**Type**: ☐ Basic training, ☑ Compulsory elective, ☐ Optional
☐ Final degree project, ☐ Practicum

**Duration**: Semiannual **Semester/s**: 3
**Number of credits ECTS**: 4
**Language/s**: Catalan (Spanish)

## DESCRIPTION

**BRIEF DESCRIPTION AND JUSTIFICATION** (the meaning of the course in relation to the studies. Between 100 and 200 words.)

The course is designed to be an introduction to one year in Materials Science.
In the first part of the course is to present the course is focused on emphasizing the relationship
between structure and properties in materials. The first half shows the
issues related to the structure of materials. Also included are concepts
Solid state diffusion and kinetics of phase transformations and the formation of
microstructure. Apply the principles of thermodynamics to materials and put
special attention to the description, construction and applications of diagrams
phase. Finally, we present the properties of materials and there is a small
introduction to the characterization of materials and their behavior in
Service.
The second part is a description based on the relationship estructurapropiedades,
the potential application of metallic materials • metal, ceramic and polymeric
most used.

**COMPETENCES** (of the course made in relation to preassigned competences in this area.)

• Ability to understand and apply the basic and technical skills, including other: computer graphic expression, mechanics and materials necessary for the industrial engineering practice (E2).
• Knowledge of materials science and technology that enables them to ' learning new methods and theories of dowry and versatility to adapt to new situations (E3).
• Ability to solve problems with initiative, decision making, creativity, and critical reasoning (E4).
• Ability to develop, plan and implement analytical methods and numerical mathematical modeling in the field of industrial engineering (E7).
• Ability to communicate effectively, both orally and in writing, to impart knowledge and skills in the field of engineering industrial. (T1)

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• Knowledge of the fundamentals of science, technology and chemical materials. Understanding the relationship between microstructure, synthesis or processing and material properties (CRI3)

**PREREQUISITES*** (modules, matters, courses and knowledge needed to follow the course. Can be stated that courses must have been completed.)
Competences of the earlier educational stages.

**CONTENTS** (as a relationship of the chapters that constitute the contents, or topics covered, of the course to a second level detail.)

1. - Why the Materials Science
1.1. Definition of Material
1.2. Relationship between structure and properties in materials.
1.3. The circle of materials.
1.4. Cycle of materials and development.
2. - Solid state
2.1. Physical states of materials.
2.2. Order and disorder in materials.
2.3. • State crystalline lens.
2.4. Structure of main materials.
3. - Defects in the crystal structure of materials • clear
3.1. Atomic defects.
3.2. Dislocations.
3.3. Dimensional defects.
4. - Diffusion in Solid State
4.1. Diffusion mechanism
4.2. Steady-state diffusion. 1 st Fick law
4.3. Diffusion in non-stationary. Fick's 2 nd Law
4.4. Dependence of diffusion.
5. - solidification
5.1. Homogeneous and heterogeneous nucleation
5.2. Super-cooled thermal and constitutional
3/5 solidification mold
6. - Alloys and phase diagrams
6.1. Alloys.
6.2. Theory of phase diagrams.
6.3. Phase equilibria in binary systems. Application materials.
6.4. Phase transformation
6.5. Microstructures.
7. - Mechanical properties of materials
7.1.: Cohesion, elasticity, plasticity and toughness.
7.2. Diagram tension / elongation.
7.3. Hardness, definition and measurement.

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7.4. Resilience: Definition and measurement
8. - Mechanical behavior of materials in service
8.1. brittle fracture
8.2. Ductile fracture.
8.3. Thermal creep.
8.4. Fatigue.
9. - Materials • Metal ions I. Ferrous materials.
11.1. Diagram Fe / C
11.2. Steels.
11.3. Foundries.
10. - Materials • Metal ions II. Non-ferrous materials
12.1. Aluminium-based alloys.
12.3. Copper based alloys.
11. - Polymeric organic materials.
13.1. Thermoplastics.
13.2. Thermostable.
13.3. Elastomers.
12. - Ceramics.

## METHODOLOGY

**TRAINNING ACTIVITIES*** (Complete the table relating activities, workload in ECTS credits, and competences.)

| Training activities | ECTS Credits | Competences |
|---|---|---|
| Sessions presentation of concepts (A1) | 1,2 | E2, E3, CRI3 |
| Sessions for resolution of exercises, problems and cases (A2) | 0 | |
| Seminars (A3) | 0 | |
| Personal mandatory activities professor-student (A4) | 0,3 | E4, E7 |
| Practical work / laboratory (A5) | 0,4 | E4, E7 |
| Oral and writing presentations (A6) | 0,2 | T1 |
| Personal study activities by students (A7) | 1,6 | E2, E3, CRI3 |
| Evaluation activities (exams, tests,…) (A8) | 0,3 | E4 |
| **TOTAL** | **4** | |

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**EXPLANATION OF THE TEACHING METHODOLOGY** (justifying the teaching methods used in relation to the competences and course contents. Between 100 and 200 words.)

The methodology combines lectures with laboratory work and work using interactive Internet. Thus, there are two hours of lectures a week during the two semesters to advance slowly and gradually throughout the agenda.
Students should make 8 practices in the enclosure for a period of 4 weeks
- Crystal growth during solidification • lens
- Preparation materialográfica
- DSC and TGA as techniques for characterization of polymers
- Fundamentals of light microscopy
- Hardness of paintings
- Work in annealed and cold
- Transformations in solid steels
- Distribution of molecular weights of polymers
- Fundamentals of rheometer
- Monitoring of the vulcanization
- Synthesis of materials by sol-gel method
- Synthesis and properties of conducting polypyrrole
- Characterization of surface activity by IGC

By the end of each chapter, the student works through the course page Blackboard ® a self-assessment quiz. To continue its evolution, Results are sent directly to the teacher. The same applies to the work of practices. During the course organized 4 years in wiki format. students must write, via a web application, the answer to a topic related to the course. After the correction and evaluation by teachers of the course, these chapters are available to students preparing for the examinations of the course. Within each chapter raises a number of questions that students can answer the teacher via email and allow students to continue learning. the practices are presented in written reports are made public and the 4 of them preinformes two and the last two reports are performed as part of the Wiki the asignaatura.

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## EVALUATION

**EVALUATION METHODS*** (Fill in the table relating evaluation methods, competences and weight in the qualification of the subject.)

| Evaluation Methods | Weight | Competences |
|---|---|---|
| Final Exam (A) | 50% | E2, E3, E4, CRI3 |
| Examination / s Partial / s / control / s scheduled / s (B) | | |
| Activities done in class (C) | 5% | CRI3 |
| Exercises outside of class (D) | | |
| Presentations and / or oral examinations (F) | 5% | T1, CRI3 |
| Modeling, Proposed, etc.. (G) | 20% | E2, E4, E7, CRI3 |
| Laboratory reports (H) | 15% | T1, CRI3 |
| Practical work / lab (I) | 5% | E4, CRI3 |

**LEARNING OUTCOMES** (Explanation of the achievements of students that allow competences evaluation, relating to competences and evaluation methods.)

• The student will be able to answer theoretical questions in the final exam. [A].
• The student will demonstrate a basic understanding of the relationship between structure and properties .. [A]
• The student will be able to give answers and share ideas electronically. [G, H].
• The student will be able to solve "cases" on the final exam. [A].
• The student will be able to present their ideas in public. [I]
• • The student will be able to test materials in the laboratory. [H, I].
• The student will be able to present their ideas in public. [F]

**QUALIFICATION** (Explanation of the calculation system of qualifying the course.)

A. . At the end of the course makes the final exam is required to pass the course (50% of the final mark). The minimum grade average for the other notes is 4 (40% of total)
B. Test: After each group • cpítol it is a test page on the Blackboard ® subject. The results are automatically sent to the teacher. Each practice has also assigned a test. Students should be made before starting work the laboratory.
C. Work at home: During the course organized 4 years in wiki format. the Students must write via a web application, response to a topic

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the subject. In addition, the proposed class teacher after each chapter
specific question. Students can discuss with your peers and the teacher, using the on-line forum to the website of the course in
Blackboard ®. The result of these exercises correspond to 10% of the final
D. Oral presentations: Students must present their respective
laboratory work. The note of the oral presentation is 10% of the final grade.
E. It promotes participation in class, but has no influence on the final result.
F. Reporting Practices: Students must submit relevant reports to 8
His laboratory work in different formats. The average grade of 4 best
comments is 10% of the total mark.
G. Presence in the Laboratory: Laboratory attendance is mandatory.
H. Be reviewed in the office of teacher work done by students in 3
weeks. The outcome of this review will be about 10% of the final grade.
I. Because of continuous assessment exercises may mean the final exam
the average should be greater than 7 (70%).
J. The approval of the subject is achieved when the average of the final exam and continuous assessment exercises is over 6 (60%)

**EVALUATION OF COMPETENCES** (Defining expressions of calculation for each competence based on corresponding evaluations activities.)

To evaluate the skills of the subject (E2, E3, E4, E7, T1, CRI3) each
an assessment of the activities of the note reflected powers
acquired. The ability to understand and apply basic technical knowledge
computer graphic expression, mechanics and materials (E2) will be evaluated in developing wikis as well as the final exam. The competition will be assessed with aspects E3
Specific questions on the final exam. The competition will be evaluated on E4
Troubleshooting the final exam, scheduled and controls the work
practical laboratory project and considering the methodology of solving the
treatment results, the application of modeling and simulation. The competition is E7
measured with the development of models of lever mechanisms for the project and making a physical model. Competition is measured T1 delimiting capability
present and defend the work reports. Competition is measured in paragraphs CRI3
specific final exam, scheduled checks, project, practices and
presentations measuring knowledge of materials science. each activity
assessment will have a maximum score of 100 points will be divided into amounts
quantify the degree of acquisition of skills by the student.

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## TEXTBOOKS (recommended and accessible to students.)


· Ashby, M.F., Jones, D. R., , P.L. Materiales para Ingeniería 1, Introducción a las propiedades, las aplicaciones y el diseño., Ed. Reverté, Barcelona, 1ª Edició 2010.
· Ashby, M.F., Jones, D. R., , P.L. Materiales para Ingeniería 2, Introducción a la microestructura, el procesamiento y el diseño., Ed. Reverté, Barcelona, 1ª Edició 2010
· Mangonon, P.L. Ciencia de Materiales, Selección y Diseño, , Ed. Prentice Hall, Mexico, 1ª Edition 2001
·Callister, W., Ciencia e Ingenieria de los Materiales, Ed. Reverté, Barcelona 3era Edition1999.
·Smith, W., Fundamentos de la Ciencia e Ingenieria de los Materiales, Ed. McGraw-Hill, Madrid 1997.
·Kurs, W., et al., Introduction à la Science des Materiaux, Ed. Presses Polytechniques et Universitaires Romandes, Lausanne, 1993.
·Llasheras, J.M.; Carrasquilla, J., Ciencia de los Materiales, Ed. Donostiarra, San Sebastián 1991.
· Flinn, R., Trojan, P., Materiales de Ingenieria y sus aplicaciones, Ed. McGraw-Hill, Madrid 1999.
·Grossberg, Alexander Yu., Khokhlov, A.R., Giant Molecules, Here, There and Everywhere, 1a Edition, Ed. Academic Press, Nova York, 1997.
BIBLIOGRAFÍA o MATERIAL COMPLEMENTARIO:
CD ROM
· University of Wisconsin, Solid State Resources JCE Software
· Russ, J.V., Materials Science: A multimedia approach PWS Publishing Company, 1995
· Mathias, L.J., et al. Macrogallery, , MRG Polymer Press, University of Southern Mississipi, Hattiesburg (MS), 1998
INTERNET:
·Visualizing Materials Science: vims.ncsu.edu/index.acgi



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## HISTORICAL DOCUMENT

**EARLIER CHANGES**

**LAST REVISION**

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