



## IDENTIFYING DATA

### Materials science and technology

|                     |  |           |      |            |
|---------------------|--|-----------|------|------------|
| Subject             | Materials science and technology   |           |      |            |
| Code                | V12G380V01301  |           |      |            |
| Study programme     | Grado en Ingeniería Mecánica   |           |      |            |
| Descriptors         | ECTS Credits   | Choose    | Year | Quadmester |
|                     | 6  | Mandatory | 2nd  | 2nd        |
| Teaching language   | #EnglishFriendly<br>Spanish<br>Galician  |           |      |            |
| Department          |  |           |      |            |
| Coordinator         | Figueroa Martínez, Raúl<br>Abreu Fernández, Carmen María   |           |      |            |
| Lecturers           | Abreu Fernández, Carmen María<br>Cortes Redin, María Begoña<br>Díaz Fernández, Belén<br>Feijó Vázquez, Iria<br>Figueroa Martínez, Raúl<br>Iglesias Rodríguez, Fernando<br>Pérez Pérez, María del Carmen<br>Riobó Coya, Cristina<br>Vázquez Castro, Alfonso |           |      |            |
| E-mail              | cabreu@uvigo.es<br>raulfm@uvigo.es   |           |      |            |
| Web                 | <a href="http://moovi.uvigo.gal/">http://moovi.uvigo.gal/</a>  |           |      |            |
| General description | The aim of this subject is to introduce the main concepts of materials technology as well as to study applications of the most common materials  |           |      |            |

## Skills

|      |  |
|------|--|
| Code |  |
| B3   | CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.  |
| B4   | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty. |
| B6   | CG6 Capacity for handling specifications, regulations and mandatory standards.   |
| C9   | CE9 Knowledge of the fundamentals of the science, technology and chemistry of materials. Understand the relationship between microstructure, the synthesis, processing and properties of materials.                            |
| D1   | CT1 Analysis and synthesis   |
| D5   | CT5 Information Management.  |
| D9   | CT9 Apply knowledge.   |
| D10  | CT10 Self learning and work.   |

## Learning outcomes

| Expected results from this subject  | Training and Learning Results |    |     |
|---|-------------------------------|----|-----|
| It comprises the fundamental concepts of link, structure and microstructure of the distinct types of materials                  | B3                            | C9 | D10 |
| It comprises the relation go in to microstructure of the material in his mechanical behaviour, electrical, thermal and magnetic | B3                            | C9 |     |
| It comprises the mechanical behaviour of the metallic materials, ceramic, plastics and compound                                 | B4<br>B6                      |    |     |
| It knows how they can modify the properties by means of mechanical processes and thermal treatments                             | B4                            | C9 | D9  |

|  |          |    |          |
|--|----------|----|----------|
| It knows the basic technicians of structural characterisation of the materials | B3<br>B6 | C9 |          |
| It purchases skills in the handle of the diagrams and charts                   |          |    | D1<br>D5 |
| It purchases skill in the realisation of essays                                | B6       | C9 | D10      |
| It analyses the results obtained and extracts conclusions of the same          |          |    | D1<br>D9 |
| It is able to apply norms of essays of materials                               | B6       |    | D1<br>D9 |

## Contents

| Topic  |   |
|--|---|
| Introduction                                   | Introduction to the Science and Technology of Material. Classification of the materials. Terminology. Orientations for the follow-up of the matter.   |
| Crystalline arrangement.                       | Crystalline and amorphous solids. Crystalline lattices, characteristics and imperfections. Allotropic transformations.  |
| Properties of materials. Laboratory practices. | Mechanical, chemical, thermal, electric and magnetic properties. Standards for materials analysis. Compressive and tensile deformation. Principles of fracture mechanisms. Toughness. Hardness. Main test methods. Introduction to metallography. Binary isomorphous and eutectic systems. Microstructure in eutectic alloys. Analyses of practical situations. |
| Metallic materials.                            | Solidification. Constitution of alloys. Grain size. Main binary phase diagrams. Processing. Carbon steels: classification and applications. Cast iron alloys. Heat treatments: aims, fundamentals and classification. Annealing, normalizing, quenching and tempering. Nonferrous alloys.   |
| Plastic materials                              | Classification according to the molecular structure: Thermoplastics, thermosets and elastomers. Properties and assessing methods. Forming processes. Introduction to the Composite Materials.   |
| Ceramic materials                              | Classification and properties. Glasses and traditional ceramics. Technical Ceramics. Cements: phases, types and main applications. Concrete. Processing of ceramic materials.   |

## Planning

|   | Class hours | Hours outside the classroom | Total hours |
|---|-------------|-----------------------------|-------------|
| Introductory activities                               | 1           | 0                           | 1           |
| Lecturing   | 31          | 56                          | 87          |
| Laboratory practical                                  | 16.75       | 18                          | 34.75       |
| Autonomous problem solving                            | 0           | 12.2                        | 12.2        |
| Mentored work   | 0.5         | 9                           | 9.5         |
| Problem and/or exercise solving                       | 1.5         | 0                           | 1.5         |
| Presentation  | 0.25        | 0                           | 0.25        |
| Report of practices, practicum and external practices | 0           | 2                           | 2           |
| Self-assessment                                       | 0           | 0.3                         | 0.3         |
| Objective questions exam                              | 1.5         | 0                           | 1.5         |

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

|                            | Description  |
|----------------------------|--|
| Introductory activities    | A presentation of the course is made: contents, organization, methodologies to be used, schedule and evaluation system. Emphasis is placed on student participation and the personalized tutoring system.  |
| Lecturing                  | During the academic course, the teacher exposes the main contents of the course, encouraging the active participation of the students. Exercises and type problems are solved, and hands on science methodology will be also applied.  |
| Laboratory practical       | Activities for the practical application of the knowledge acquired in the theoretical sessions. They are performed in the laboratory with specialized equipment and in accordance with applicable standards  |
| Autonomous problem solving | Throughout the course, students will be offered different set of problems and questions that they will have to solve by themselves, demonstrating the capacity for learning and developing autonomous work.  |
| Mentored work              | The instructor will propose several projects to be carried out in small groups. The projects will be related to the characterization of materials commonly used in technological applications. Students must complete a revision of the literature concerning to the topic of the project, revise the existing standards and other sources of information. Finally, the project must be exposed to the instructor and to their classmates. |

| <b>Personalized assistance</b>                        |  |
|---|--|
| <b>Methodologies</b>                                  | <b>Description</b>   |
| Lecturing   | The teacher will guide and resolve any doubts that the student may have in relation to the contents explained in the lectures.   |
| Laboratory practical                                  | The laboratory teacher will guide the students in the development of the practical classes, clarifying their doubts and guiding them to achieve the best understanding of the practical classes                  |
| Mentored work   | During the development of the tasks proposed to be done in small groups, the students will have the guidance and help of the teacher   |
| <b>Tests</b>  | <b>Description</b>   |
| Problem and/or exercise solving                       | The students will have the support of the teacher to solve the doubts that can arise in the resolution of the numerical problems proposed in class, as well as those that are offered for their autonomous work. |
| Report of practices, practicum and external practices | The laboratory teacher will guide the students in the resolution of the questions formulated in the practical classes and will help in the doubts that may arise in the writing of the practical reports.        |
| Self-assessment                                       | The teacher will design the self-assessment tests that the student must take throughout the course, and will guide the students in their completion, solving the technical questions that may arise              |

| <b>Assessment</b>                                     |  |               |                               |                             |
|---|--|---------------|-------------------------------|-----------------------------|
|   | Description  | Qualification | Training and Learning Results |                             |
| Laboratory practical                                  | The attendance and active participation of the student in the practical sessions will be valued  | 1             | B3<br>B6                      | C9<br>D1<br>D9<br>D10       |
| Problem and/or exercise solving                       | Student learning in practical sessions will be evaluated by means of a written exam, which will include of exercises and problems (7%)<br>The final exam will include of problems and exercises similar to those raised during the course (35%)                                  | 42            | B4<br>B6                      | C9<br>D1<br>D9<br>D10       |
| Presentation  | The projects will be assessed after the oral exposition. These are the items to be taken into account for the assessment: revised literature, structure of the contents used in the presentation and ability to reply to the comments given by the instructor and/or classmates. | 7             | B4<br>B6                      | C9<br>D1<br>D5<br>D10       |
| Report of practices, practicum and external practices | The student must present a report of the practical sessions which will include the results obtained in the mechanical tests as well as the answers to the questions asked.   | 4             | B6                            | C9<br>D9                    |
| Self-assessment                                       | Resolution of proposed online questionnaires, which will consist of true and false questions and multiple choice questions   | 4             | B3                            | C9<br>D9<br>D10             |
| Objective questions exam                              | Student learning in practical sessions will be evaluated by means of a written exam, which will include of short answer questions and test questions (7%)<br>The final exam will include short answer questions and test questions (35%)   | 42            | B3<br>B4                      | C9<br>D1<br>D5<br>D9<br>D10 |

### **Other comments on the Evaluation**

**Continuous assessment:** The continuous assessment activities will be carried out during the teaching period and correspond to 30% of the grade.

**Final Exam:** counts for 70% of the course grade. The exam will be taken on the official date set by the EEI direction.

### **Requirements to pass the course:**

It is necessary to achieve a minimum score of 40% in the final exam, that is 2.8 / 7.

If this minimum is not reached, the course will be considered as not passed and, although the sum of the exam grade and the continuous evaluation is higher than 5, the maximum grade that will be included in the academic records will be 4.5 points.

**Renouncing continuous assessment:** Students that do not follow the continuous assessment activities, after receiving authorization from the EEI direction, will be evaluated through a final exam on the contents of all the course, covering both lecture and labo contents, counting for 100% of the grade. A minimum mark of 5 (50%) will be required to

pass the course.

**July exam (2nd Edition):** In the July edition, the continuous assessment marks will be also considered (only marks obtained in the current academic year). The characteristics of the exam will be the same as the first edition, and will be taken on the official date set by the EEI direction. Further in the July edition, the student can choose to be evaluated through a final exam on the contents of all the course, covering both lecture and labo contents, counting for 100% of the grade. A minimum mark of 5 (50%) will be required to pass the course. The student must notify the teacher of their choice well in advance.

**Extraordinary Call:** The extraordinary call exam contents will cover the entire course, including both lecture and labo contents, counting for 100% o the grade. A minimum mark of 5 (50%) will be required to pass the course.

**Ethical commitment:** Students are expected to carry out their work in accordance with an appropriate ethical behaviour. If the professor detects a behaviour that constitutes academic dishonesty (cheating, plagiarism, use of unauthorized electronic devices, for example) the student will be deemed not to meet all the criteria to pass the course, and will be informed that the final grade of this course will be FAIL (0.0). The use of any electronic device will not be allowed during the evaluation tests, unless expressly authorized. Introducing an unauthorized electronic device into the exam room will be considered reason enough for not passing the course in the present academic year, and the final grade will be: FAIL (0.0).

**Attention: If there is any mismatch between the contents of the 3 language versions of this teaching guide, those included in the Spanish version will be considered valid.**

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### Sources of information

#### Basic Bibliography

Callister, William, **Ciencia e ingeniería de los materiales**, 2ª, Reverté, 2016

Askeland, Donald R, **Ciencia e ingeniería de materiales**, 6ª, Cengage Learning, 2012

Shackelford, James F, **Introducción a la ciencia de materiales para ingenieros**, 7ª, Pearson Educación, 2010

#### Complementary Bibliography

Smith, William F, **Fundamentos de la ciencia e ingeniería de materiales**, 5ª, McGraw-Hill, 2010

#### AENOR, Standard tests,

Montes J.M., Cuevas F.G., Cintas J., **Ciencia e ingeniería de los materiales / J.M. Montes, F.G. Cuevas, J. Cintas**, 1ª, Paraninfo, 2014

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### Recommendations

#### Subjects that continue the syllabus

Materials engineering/V12G380V01504

#### Subjects that are recommended to be taken simultaneously

Fundamentals of manufacturing systems and technologies/V12G380V01305

Fluid mechanics/V12G380V01405

Thermodynamics and heat transfer/V12G380V01302

#### Subjects that it is recommended to have taken before

Computer science: Computing for engineering/V12G350V01203

Physics: Physics I/V12G380V01102

Physics: Physics II/V12G380V01202

Mathematics: Algebra and statistics/V12G380V01103

Mathematics: Calculus I/V12G380V01104

Chemistry: Chemistry/V12G380V01205