Course guides
320007 - CTM - Materials Science and Technology

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: BACHELOR’S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR’S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2020  ECTS Credits: 6.0  Languages: Spanish

LECTURER

Coordinating lecturer: DAVID ARENCÓN OSUNA
Others: MARCELO DE SOUSA PAIS ANTUNES VERA CRISTINA DE REDONDO REALINHO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. IND_COMMON: Knowledge of the science principles, technology and materials. Understanding the relation between the microstructure, synthesis or processing and properties of these materials.

Transversal:
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.
TEACHING METHODOLOGY

- Face-to-face lecture sessions
Lectures are given using digital presentations. The presentations will be made available to students on the virtual campus before classes begin to help them follow them. The assessment will be based on mid-semester examinations (or an optional final examination for students who fail the first one).
- Face-to-face practical work sessions
During practical work sessions, students work individually or in small groups of 2-3 on problems and questions under the lecturer's supervision. A collection of problems will be made available on the virtual campus. Systems for self-assessment (with assessment criteria or rubrics), co-assessment (among students) and delivery of reports, corrected by the teacher and returned, are made available to facilitate independent learning.
- Face-to-face laboratory work sessions
Students work in pairs during laboratory sessions. Guidelines for practicals will be made available to students on the virtual campus at the start of the course. Students must hand in a report for each practical. Marks will be based on the work carried out in the laboratory and the reports handed in.

LEARNING OBJECTIVES OF THE SUBJECT

On completion of the course, students should be able to:
- Correctly use and interpret the language and basic concepts of Chemistry.
- Recognise the structure of matter and relate it to the physical and chemical properties of organic and inorganic substances.
- Apply stoichiometric calculations to solve problems.
- Recognise the equipment and apply the basic techniques of the chemistry laboratory.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

TOPIC 1: INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING

Description:
- Fundamentals
- Historical evolution
- Properties and structure
- Classification of materials

Related activities:
Activity 1.

Full-or-part-time: 5h
Theory classes: 2h
Self study : 3h
TOPIC 2: STRUCTURE OF CRYSTALLINE SOLIDS

Description:
- Concept of unit cell
- Main crystalline structure of pure metals: BCC, FCC, HCP
- Crystallographic directions and plans: lineal atomic and area atomic densities
- Density and atomic packing factor

Related activities:
Activities 1, 2, 4 and 5.

Full-or-part-time: 16h
Theory classes: 4h
Practical classes: 2h
Self study: 10h

TOPIC 3: SOLIDIFICATION, CRYSTALLOGRAPHIC DEFECTS AND DIFFUSION IN SOLIDS

Description:
- Nucleation and crystalline growth
- Crystalline defects: point, line, planar, bulk
- Diffusión: stationary and non-stationary state

Related activities:
Activities 1, 2, 4 and 5.

Full-or-part-time: 16h
Theory classes: 5h
Practical classes: 1h
Self study: 10h

TOPIC 4: MECHANICAL PROPERTIES

Description:
- Stress and deformation
- Isotropy/anisotropy
- Elasticity and plasticity
- Young's modulus, Poisson's ratio, elastic limit, maximum strength, rupture deformation, resilience, toughness
- Plastic deformation mechanisms in metals
- Metal hardening
- Creep
- Fracture
- Fatigue

Related activities:
Activities 1, 2, 3, 4 and 5.

Full-or-part-time: 17h
Theory classes: 5h
Practical classes: 2h
Self study: 10h
TOPIC 5: EQUILIBRIUM PHASE DIAGRAMS

Description:
- Definition of phase. Gibb’s rule of phases
- Solid solutions
- Analysis rules for binary phase diagrams
- Binary phase diagrams: type I, II, III, IV
- Invariant transformations: eutectic, eutectoid, peritectic

Related activities:
Activities 1, 2, 3, 4 and 5.

Full-or-part-time: 16h
Theory classes: 4h
Practical classes: 2h
Self study: 10h

TOPIC 6: METAL ALLOYS

Description:
- Ferric alloys: steel and cast iron
- Non-equilibrium microstructures in ferric alloys. Main thermal treatments
- Non-ferric alloys
- Processing technologies of metallic alloys

Related activities:
Activities 1, 2, 3, 4 and 5.

Full-or-part-time: 17h
Theory classes: 5h
Practical classes: 2h
Self study: 10h

TOPIC 7: CERAMICS AND GLASS

Description:
- Main characteristics of glasses, traditional ceramics and high demanding ceramics
- Structure of glasses, traditional ceramics and high demanding ceramics
- Processing technologies of glasses, traditional ceramics and high demanding ceramics

Related activities:
Activities 1, 2, 3, 4 and 5.

Full-or-part-time: 15h 40m
Theory classes: 5h
Practical classes: 1h
Self study: 9h 40m
TOPIC 8: PLASTIC MATERIALS

Description:
- Polymerization processes
- Average molecular mass of polymers
- Branching, isomeria and copolimerization
- Plastics: thermoplastic, thermosetting, elastomer
- Polymers: amorphous and semicrystalline
- Processing technology of thermoplastic polymers

Related activities:
Activities 1, 2, 3, 4 and 5.

Full-or-part-time: 16h
Theory classes: 5h
Practical classes: 1h
Self study: 10h

TOPIC 9: COMPOSITE MATERIALS

Description:
- Matrix and reinforcement
- Matrix classification of composites: polymeric, metallic, ceramic
- Reinforcement classification of composites: particulate, fiber, structural
- Predictive models of some physical properties
- Processing technology of composite materials

Related activities:
Activities 1, 2, 3, 4 and 5.

Full-or-part-time: 14h 50m
Theory classes: 5h
Practical classes: 1h
Self study: 8h 50m

ACTIVITIES

ACTIVITY 1: THEROETICAL CLASSES

Full-or-part-time: 69h
Theory classes: 24h
Self study: 45h

ACTIVITY 2: PRACTICAL CLASSES

Full-or-part-time: 37h 30m
Practical classes: 15h
Self study: 22h 30m
ACTIVITY 3: LAB SESSIONS

Full-or-part-time: 37h 30m
Laboratory classes: 15h
Self study: 22h 30m

ACTIVITY 4: PARTIAL EXAM

Full-or-part-time: 3h
Theory classes: 3h

ACTIVITY 5: 2nd MIDSEASON EXAM

Full-or-part-time: 3h
Theory classes: 3h

GRADING SYSTEM

- First examination (NP1): 42.5%
- Second examination (NP2): 42.5%
- Laboratory sessions (NLB): 15%

La nota global s'obté de la següent expressió:

\[ \text{Global grade} = 0.425 \times \text{NP1} + 0.425 \times \text{NP2} + 0.15 \times \text{NPL} \]

The students may in second term exam (June) have a final exam (NFIN) of all the subject content. This exam contain the topics of first term (NPR1) and topics of second term (NP2). If NPR1 is lower than NP1, NP1 grade will remain for the global grade. For these students, the global grade comes from the following expression:

\[ \text{Global grade} = 0.425 \times \text{NPR1} + 0.425 \times \text{NP2} + 0.15 \times \text{NPL} \]

EXAMINATION RULES.

It is compulsory to attend the laboratory practical sessions. The assessment of NPL marks will be exposed through virtual campus Atenea at the beginning of the semester.

BIBLIOGRAPHY

Basic:
- Callister, W.D. Introducción a la ciencia e ingeniería de los materiales (vol. 1 y vol. 2). Barcelona: Reverté, 1995-1996. ISBN 842917253X.

Complementary:
- Saja Saez, J.A. de; Rodríguez Pérez, M.Á.; Rodríguez Méndez, M.L. Materiales: estructura, propiedades y aplicaciones. Madrid: