Course guide
320007 - CTM - Materials Science and Technology

Last modified: 02/04/2024

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 CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL 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: 2024 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: FARAYDE MATTA FAKHOURI

Primer quadrimestre:
DAVID ARENCON OSUNA - Grup: 11

Others: Primer quadrimestre:
DAVID ARENCON OSUNA - Grup: 11
M. DEL PILAR CASAS CARNE - Grup: 11, Grup: 12, Grup: 13, Grup: 14
VICENTE MARQUES CIFRE - Grup: 12
FARAYDE MATTA FAKHOURI - Grup: 11, Grup: 12, Grup: 13, Grup: 14
KHALIL TAFZI EL HADRI - Grup: 11

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CED10-DIDP. Knowledge of principles of material science and technology for the selection of materials and their processes, and their impact on the design, redesign, and development of products. (Common module for the industrial branch).
CE09-INDUS. Knowledge of the fundamentals of science, technology, and material chemistry. Understanding the relationship between microstructure, synthesis or processing, and material properties. (Common module for industrial engineering)

Transversal:
CT03 N2. Efficient oral and written communication - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

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

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours medium group	15,0	10.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

TOPIC 1: INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING

Description:
-Fundamentals
-Historical evolution
-Properties and stucture
-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
-Difusión: 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
-Processsing 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, isomería 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
Self study: 45h
Theory classes: 24h

ACTIVITY 2: PRACTICAL CLASSES

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

ACTIVITY 3: LAB SESSIONS

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

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:

Global grade = 0.425 NP1 + 0.425 NP2 + 0.15 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:

Global grade = 0.425 NPR1 + 0.425NP2 + 0.15 NPL

EXAMINATION RULES.

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

BIBLIOGRAPHY

Basic:

- Callister, William D.; Rethwisch, David G. Ciencia e ingeniería de materiales [on line]. 2a ed. Barcelona: Reverté, 2018 [Consultation: 08/03/2023]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=9589. ISBN 9788429195491.
- Shackelford, J. F. Introducción a la ciencia de materiales para ingenieros [on line]. 7ª ed. Madrid: Pearson Educación, 2010 [Consultation: 09/05/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1258. ISBN 9788483229606.
- Askeland, D.R. Ciencia e ingenieria de los materiales. Madrid: International Thomson Editores, 2001. ISBN 8497320166.

Complementary:

- Smith, W.F.; Hashemi, J.; Murrieta, J.E. Fundamentos de la ciencia e ingeniería de los materiales. 7a ed. México: McGraw-Hill, 2023. ISBN 9781456294878.
- Saja Saez, J.A. de; Rodríguez Pérez, M.Á.; Rodríguez Méndez, M.L. Materiales: estructura, propiedades y aplicaciones. Madrid: Thomson Paraninfo, 2005. ISBN 8497323467.
- Casanovas, J.; Alemán, C. Introducción a la ciencia de los materiales. Barcelona: Cálamo Producciones Editoriales, 2002. ISBN 8495860112.
- Barroso, Segundo; Ibáñez, Joaquín. Introducción al conocimiento de materiales [on line]. Madrid: UNED, 2014 [Consultation: 18/04/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3219230. ISBN 8436268598.
- John, V.B. Ingeniería de materiales. [Wilmington]: Addison-Wesley Iberoamericana, 1994. ISBN 0201601451.
- Gil, F.J.; Cabrera, J.M.; Maspoch M.Ll. Materiales en ingeniería: problemas resueltos. 2ª ed. Barcelona: Edicions UPC, 2002. ISBN 9701507746.
- Barroso Herrero, S; Gil Bercero, J.R. Construcción e interpretación de diagramas de fase binarios. Madrid: UNED, 2004.