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320007 - CTM - Materials Science and Technology

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 702 - CMEM - Department of Materials Science and Metallurgy

Academic year: 2019

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

ECTS credits: 6 Teaching languages: Spanish

Teaching staff

Coordinator: 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:

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.
2. SELF-DIRECTED LEARNING - Level 1. Completing set tasks within established deadlines. Working with recommended information sources according to the guidelines set by lecturers.
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.

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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

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	15h	10.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

TOPIC 1: INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING

Learning time: 5h

Theory classes: 2h
Self study : 3h

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

Related activities:
Activity 1.

TOPIC 2: STRUCTURE OF CRYSTALLINE SOLIDS

Learning time: 16h

Theory classes: 4h
Practical classes: 2h
Self study : 10h

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.

TOPIC 3: SOLIDIFICATION, CRYSTALLOGRAPHIC DEFECTS AND DIFFUSION IN SOLIDS

Learning time: 16h

Theory classes: 5h
Practical classes: 1h
Self study : 10h

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.

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TOPIC 4: MECHANICAL PROPERTIES	Learning time: 17h Theory classes: 5h Practical classes: 2h Self study : 10h

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.

TOPIC 5: EQUILIBRIUM PHASE DIAGRAMS	Learning time: 16h Theory classes: 4h Practical classes: 2h Self study : 10h

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.

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TOPIC 6: METAL ALLOYS	Learning time: 17h Theory classes: 5h Practical classes: 2h Self study : 10h

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.

TOPIC 7: CERAMICS AND GLASS	Learning time: 15h 40m Theory classes: 5h Practical classes: 1h Self study : 9h 40m

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.

TOPIC 8: PLASTIC MATERIALS	Learning time: 16h Theory classes: 5h Practical classes: 1h Self study : 10h

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.

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TOPIC 9: COMPOSITE MATERIALS	Learning time: 14h 50m Theory classes: 5h Practical classes: 1h Self study : 8h 50m

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.

Planning of activities

ACTIVITY 1: THEROETICAL CLASSES	Hours: 69h Theory classes: 24h Self study: 45h

ACTIVITY 2: PRACTICAL CLASSES	Hours: 37h 30m Practical classes: 15h Self study: 22h 30m

ACTIVITY 3: LAB SESSIONS	Hours: 37h 30m Laboratory classes: 15h Self study: 22h 30m

ACTIVITY 4: PARTIAL EXAM	Hours: 3h Theory classes: 3h

ACTIVITY 5: 2nd MIDSEASON EXAM	Hours: 3h Theory classes: 3h

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Qualification 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

Regulations for carrying out activities

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:

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Askeland, D.R. Ciencia e ingenieria de los materiales. Madrid: International Thomson Editores, 2001. ISBN 8497320166.

Complementary:

Smith, W.F. Fundamentos de la ciencia e ingeniería de materiales. 2ª ed. Madrid: McGraw-Hill, 1998. ISBN 8448114299.

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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.