Course guide
240EM142 - 240EM142 - Materials for Energy Applications

Last modified: 26/06/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2025 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: LUIS MIGUEL LLANES PITARCH

Others: Segon quadrimestre:
PABLO GUARDIA GIRÓS - T10

PRIOR SKILLS

No one previous capacity.

REQUIREMENTS

No one requirement.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMCEM-02. (ENG) Dissenyar i desenvolupar productes, processos, sistemes i serveis, així com l'optimització d'altres ja desenvolupats, atenent a la selecció de materials per a aplicacions específiques
CEMCEM-03. (ENG) Aplicar mètodes innovadors en la resolució de problemes i aplicacions informàtiques adequades, pel disseny, simulació, optimització i control de processos de producció i transformació de materials
CEMCEM-07. (ENG) Dissenyar, calcular i modelar aspectes relacionats amb els materials per a components mecànics, estructures i equips

Transversal:
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

It will include lectures, seminars, industrial visits, participative sessions, exercises, among others. Students will choose a subject related to the course on which they will write a midterm and final project. Both projects will be presented in front the class by means an oral presentation. Several guest lecturers will be invited to describe their own area of expertise.

LEARNING OBJECTIVES OF THE SUBJECT

During the academic course, it is requited the knowledge of the following goals:
(i) To present an overview of energy as key feature regarding materials energy content (production, processing, use and recycling).
(ii) To show the critical role played by advanced materials for enabling efficient energy, transformation and storage, as well as energy-efficient transportation and housing.

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours large group	40,5	36.00

Total learning time: 112.5 h

CONTENTS

1. Energy and the Environment

Description:
The global energy landscape and energy security.

Related activities:
Conceptual maps.
Directed activities.
Midterm and final projects.

Full-or-part-time: 10h
Practical classes: 3h
Guided activities: 2h
Self study : 5h

2. Materials energy content

Description:
Definition in terms of production, processing, use and recycling. Life-cycle assessment. Energy cost of materials. Economics of materials. Global materials flows.

Full-or-part-time: 21h
Theory classes: 9h
Practical classes: 7h 30m
Guided activities: 4h 30m

3. Energy sources

Description:
Nonrenewable energy sources. Renewable energy sources.

Full-or-part-time: 9h
Practical classes: 3h
Self study : 6h

4. Advanced materials for enabling efficient energy harvesting.

Description:
Solar cells, nuclear materials, hard materials for oil/gas recovery, composites for wind energy, thermoelectrics.

Full-or-part-time: 10h
Practical classes: 3h
Guided activities: 2h
Self study : 5h

5. Advanced materials for enabling energy transformation.

Description:
Fuel cells, light emitting diodes, engines and turbines.

Full-or-part-time: 10h
Practical classes: 3h
Guided activities: 2h
Self study : 5h

6. Advanced materials for enabling energy storage.

Description:
Hydrogen storage, phase change materials.

Full-or-part-time: 7h 30m
Practical classes: 1h 30m
Guided activities: 1h 30m
Self study : 4h 30m

7. Advanced materials for energy-efficient industry related applications: transportation, manufacturing and housing.

Description:
Case studies related to effective implementation of materials in reference applications of industrial sectors: transportation, manufacturing and housing, among others.

Full-or-part-time: 27h
Practical classes: 6h
Guided activities: 6h
Self study : 15h

GRADING SYSTEM

? Short oral assessments (individual) (15%) ? between 4 and 5 activities along the course
? Midterm oral/written assessment (group) (25%)
? Final project (group) (50%)
? Participant?s attitude (in-class participation, etc) (10%)

There will not be a reevaluation exam

EXAMINATION RULES.

The professor at the beginning of the course will supply to the students a scale (in order to evaluate the individual activities) as well as a rubric to evaluate the midterm and final Project.

BIBLIOGRAPHY

Basic:
- Ginley, David S. ; Cahen, D. Fundamentals of materials for energy and environmental sustainability. Cambridge: Cambridge University Press, 2011. ISBN 9781107000230.
- "Harnessing materials for energy". Materials research bulletin| [on line]. Vol. 33 núm. 4 (2008) 261-477 [Consultation: 04/09/2015]. Available on: http://journals.cambridge.org/action/displayFulltext?type=1&pdftype=1&fid=7960224&jid=MRS&volumeId=33&issueId=04&aid=7960223.- "Materials for sustainable development". Materials research bulletin [on line]. Vol. 37 num. 04 (2012) pp 297-458 [Consultation: 04/09/2015]. Available on: journals.cambridge.org/action/displayFulltext?type=1&pdftype=1&fid=8525645&jid=MRS&volumeId=37&issueId=04&aid=8525644.
- Callister, William D; Rethwisch, David G. Materials science and engineering : an introduction. 10th ed. New York [etc.]: John Wiley & Sons, cop. 2017. ISBN 9781119405337.