



## Course guide

### 295755 - 295EM033 - Advanced Ceramics

Last modified: 02/10/2025

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

**Degree:** MASTER'S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019). (Compulsory subject).  
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** Spanish

#### LECTURER

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**Coordinating lecturer:** MARIA PAU GINEBRA MOLINS

**Others:** Primer quadrimestre:  
ANNA DÍEZ ESCUDERO - Grup: T1  
MARIA PAU GINEBRA MOLINS - Grup: T1  
EMILIO JIMENEZ PIQUÉ - Grup: T1  
LUIS MIGUEL LLANES PITARCH - Grup: T1  
MIGUEL MORALES COMAS - Grup: T1

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEMCEAM-01. (ENG) Dissenyar i desenvolupar productes, processos i sistemes, aixó com l'optimització d'altres ja desenvolupats, atenent a la selecció de materials per aplicacions específiques.

CEMCEAM-02. (ENG) Aplicar métodos innovadores para el diseño, simulación, optimización y control de procesos de producción y transformación de materiales

CEMCEAM-05. (ENG) Interpretar y aplicar normativas y especificaciones relativas a los materiales y sus aplicaciones

**Transversal:**

06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

#### TEACHING METHODOLOGY

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#### LEARNING OBJECTIVES OF THE SUBJECT

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- 1.- Understand the microstructure and properties of advanced ceramics
- 2- Design optimal sintering and processing strategies to optimize properties
- 3- Select the best advanced ceramics for different applications
- 4- Understand the design requirements and the biological response to ceramics and glass for biomedical applications



## STUDY LOAD

Type	Hours	Percentage
Hours small group	9,0	6.00
Self study	96,0	64.00
Hours large group	45,0	30.00

**Total learning time:** 150 h

## CONTENTS

### TOPIC 1 CERAMIC STRUCTURES AND MECHANICAL PROPERTIES

**Description:**

Introduction. Advanced ceramics vs. Traditional Ceramics. Main applications. Mechanical properties. Hardness, toughness, reliability, creep.

**Full-or-part-time:** 12h 30m

Theory classes: 3h

Laboratory classes: 1h

Self study : 8h 30m

### TOPIC 2. SINTERING

**Description:**

Manufacturing: Dry routes. Wet routes. Colloids. Sintering, including FAST techniques. Monocrystals. 3D printing

**Full-or-part-time:** 25h

Theory classes: 6h

Laboratory classes: 2h

Self study : 17h

### TOPIC 3. CERAMIC TYPES

**Description:**

Oxides, carbides, nitrides. Cerments. Structural ceramics. Functional ceramics.

**Full-or-part-time:** 25h

Theory classes: 6h

Laboratory classes: 2h

Self study : 17h

### TOPIC 4: CERAMICS FOR STRUCTURAL PROSTHESIS

**Description:**

Dental ceramics. Dental implants. Ceramics for Joints. Reliability and mechanical considerations

**Full-or-part-time:** 25h

Theory classes: 6h

Laboratory classes: 2h

Guided activities: 17h



## TOPIC 5. BIOLOGICAL CERAMICS: BIOMINERALS

### Description:

Biomineralization. Structural characteristics and properties of biological ceramics. Bioceramics in biological tissues.

### Full-or-part-time: 20h

Theory classes: 3h

Self study : 17h

## TOPIC 6: BIOCERAMICS

### Description:

Bioactive ceramics and resorbable ceramics. Glass and glass ceramic for biomedical applications. Biological characterization of bioceramics

### Full-or-part-time: 63h 30m

Theory classes: 15h

Laboratory classes: 6h

Self study : 42h 30m

## GRADING SYSTEM

Final mark = 0,5\*Mark Part 1 + 0,5\*Mark Part 2

Mark Part 1 = 0,5 Exam part 1 + 0,1 deliverable 1 + 0,1 deliverable 2 + 0,3 laboratory

Nota Part 2 = 0,6 Exam part 2 + 0,1 deliverable 1 + 0,3\*laboratory

Since there is a continuous evaluation, there is no reevaluation exam

## BIBLIOGRAPHY

### Basic:

- Carter, C. Barry; Norton, M. Grant. Ceramic materials : science and engineering. 2nd ed. New York: Springer Science+Business Media, cop. 2013. ISBN 9781461435228.
- So<sup>o</sup>miya, Shigeyuki. Handbook of advanced ceramics : materials, applications, processing, and propertiesties. Second edition. Amsterdam ; Boston: Academic Press, [2013]. ISBN 9780123854698.
- Bergmann, Carlos P.; Stumpf, Aisha. Dental Ceramics: Microstructure, Properties and Degradation. Berlin: Springer, 2013. ISBN 9783642382246.
- Reza Rezaie, H.; Nasiry, M.; Rezaei Khamseh, M.M.; Öchsner, A. A Review on dental materials. Springer International Publishing, 2020. ISBN 9783030489311.
- Kokubo, Tadashi. Bioceramics and their clinical applications. Cambridge : Boca Raton, Florida: Woodhead ; CRC Press, 2008. ISBN 9781845692049.
- Rey, C., Combes, C., Drouet, C., Grossin, D., Bertrand, G., and Soulié. "Bioactive Calcium Phosphate Compounds: Physical Chemistry". Ducheyne, P., Grainger, D.W., Healy, K.E., Hutmacher, D.W., and Kirkpatrick, C.J. Comprehensive Biomaterials II. Vol. 1. Elsevier, 244.
- Kokubo, Tadashi. Bioceramics and their clinical applications. Cambridge : Boca Raton, Florida: Woodhead ; CRC Press, 2008. ISBN 9781845692049.
- Dill Pasteris, Jill; Wopenka, Brigitte; Valsami-Jones, Eugenia. "One and Tooth Mineralization : Why Apatite?". Elements. 4 (2) : 97-104.

### Complementary:

- Aldinger, Fritz; Weberruss, Volker Achim. Advanced ceramics and future materials : an introduction to structures, properties and technologies. Weinheim; Chichester: Wiley-VCH, cop. 2010. ISBN 9783527321575.