

## Course guide

### 295703 - MACE - Ceramic Materials

**Last modified:** 14/06/2023

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

**Degree:** BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 6.0    **Languages:** Spanish

#### LECTURER

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**Coordinating lecturer:** MIGUEL MORALES COMAS

**Others:** Primer quadrimestre:  
MIGUEL MORALES COMAS - Grup: M11, Grup: M12

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEI-09. Understand the fundamentals of materials science, technology and chemistry. Understand the relationship between the microstructure, synthesis or processing and the properties of materials.

CEMT-19. Knowledge of the structure of different types of materials, as well as material characterisation and analysis techniques.

CEMT-22. Knowledge and application of materials technology in the production, transformation, processing, selection, control, maintenance, recycling and storage of all types of materials.

**Transversal:**

04 COE N3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

#### TEACHING METHODOLOGY

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Theoretical class in conjunction with Laboratory: sessions and autonomous learning exercises will be done. Two exams, a presentation and small exercises will be part of the grade. Theoretical class in conjunction with Laboratory: sessions and autonomous learning exercises will be done. Two exams, a presentation and small exercises will be part of the grade.

#### LEARNING OBJECTIVES OF THE SUBJECT

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The objective of this subject is that the student will acquire the introductory knowledge and skills over structure, properties, processing, design and in-service response of traditional and advanced ceramic materials.

At the end of the course the student should be able to:

- Identify the main crystallographic structures and microstructures of ceramic materials
- Identify the main defects in ceramics, as well as formulate the main reactions between them
- Select the optimal processing route of ceramic components
- Design to optimize the structural integrity and reliability of ceramic devices.



## STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Guided activities	90,0	60.00

**Total learning time:** 150 h

## CONTENTS

### Introduction to ceramic materials

**Description:**

History of ceramic technology. Classification of ceramic materials. Crystallography of ceramics. Silicates and Aluminosilicates. Glass.

**Full-or-part-time:** 15h

Theory classes: 6h

Practical classes: 1h

Laboratory classes: 2h

Self study : 6h

### Crystallographic defects in ceramics

**Description:**

Point defects. Kröger-Vink notation. Dislocations. Pores. Grain Boundaries.

**Full-or-part-time:** 13h

Theory classes: 4h

Practical classes: 1h

Self study : 8h

### Microstructure and Phase Equilibrium

**Description:**

Ceramic phase diagrams. Phases out of equilibrium. TTT curves and glass formation. Ceramic Microstructures

**Full-or-part-time:** 10h

Theory classes: 2h

Practical classes: 2h

Self study : 6h

### Processing Technology

**Description:**

Overview of ceramic processing routes. Raw materials. Solid state sintering. Densification. Forming. Additives. Glass. Single crystals.

**Full-or-part-time:** 34h

Theory classes: 8h

Practical classes: 1h

Laboratory classes: 6h

Self study : 19h

### Design, mechanical properties and reliability

**Description:**

Design issues. Mechanical properties. Toughness and reliability of ceramics. Weibull statistics Hardness and wear.

**Full-or-part-time:** 21h

Theory classes: 5h

Practical classes: 1h

Laboratory classes: 2h

Self study : 13h

### Thermo-mechanical behaviour

**Description:**

Thermal properties. Thermo-mechanics: thermal shock and creep.

**Full-or-part-time:** 8h 30m

Theory classes: 1h

Practical classes: 1h

Laboratory classes: 2h

Self study : 4h 30m

### Engineering applications

**Description:**

Engineering applications

**Full-or-part-time:** 11h

Practical classes: 1h

Self study : 10h

## GRADING SYSTEM

60% Final Exam (15% Mid-term exam 1 + 45% Final-term exam 2) + 10 % laboratory + 30% quiz (12% presentation Lesson 2 + 18% presentation Final activity)

There will not be a reevaluation exam

## BIBLIOGRAPHY

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### Basic:

- Barsoum, M. W. Fundamentals of ceramics. London: London : Taylor & Francis, 2003. ISBN 9780750309028.
- Carter, C. Barry ; Grant Norton, M. Ceramic materials science and engineering. 2nd ed. New York: Springer, cop. 2013. ISBN 9780387462707.
- Richerson, David W. Modern ceramic engineering : properties, processing, and use in design. 3rd ed. Boca Raton, FL: CRC Taylor & Francis, 2006. ISBN 9781574446937.

### Complementary:

- Mari, Eduardo Ambrosio. Los Materiales cerámicos : un enfoque unificador sobre las cerámicas tradicionales y avanzadas, los vidrios, los cementos, los refractarios y otros materiales inorgánicos no metálicos. Buenos Aires: Alsina, 1998. ISBN 9505530552.