



# Course guide

## 295707 - MEF - Physical Metallurgy

Last modified: 27/05/2024

**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:** 2024    **ECTS Credits:** 6.0    **Languages:** Catalan, Spanish

### LECTURER

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**Coordinating lecturer:** CASIMIR CASAS QUESADA

**Others:**

Primer quadrimestre:  
CASIMIR CASAS QUESADA - Grup: M21, Grup: M22  
JOSEP ORIOL RIUS AYRA - Grup: M22  
BLAS SORITA LLEDO - Grup: M22

Segon quadrimestre:  
PERE BARRIOBERO VILA - Grup: M11, Grup: M12  
CASIMIR CASAS QUESADA - Grup: M11, Grup: M12  
JOSEP ORIOL RIUS AYRA - Grup: M11, Grup: M12

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

1. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.
3. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

**Transversal:**

04 COE N1. 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.

### TEACHING METHODOLOGY

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During the course theoretical lectures, problems and laboratory sessions are given. Combined with independent learning practice, it will make possible to relate the knowledge acquired and to achieve the expected objectives. The lectures will be primarily theoretical dissertation while problems and practices will be participatory and cooperative. Two tests will be done, and laboratory practices and sessions of problems will be evaluated.

### LEARNING OBJECTIVES OF THE SUBJECT

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The aim of the subject is that the student acquires basic knowledge about the physical metallurgy involved in solidification and transformation in solid state of materials, and in particular of metals. At the end of the course the student should be capable of:

- Identify and interpret equilibrium and no-equilibrium phase diagrams.
- Identify, calculate and formulate the kinetics of the phase transformations.
- Identify the major phase transformations.



## STUDY LOAD

| Type              | Hours | Percentage |
|-------------------|-------|------------|
| Hours small group | 10,0  | 6.67       |
| Self study        | 90,0  | 60.00      |
| Hours large group | 50,0  | 33.33      |

**Total learning time:** 150 h

## CONTENTS

### Chapter I. Equilibrium diagrams

**Description:**

Equilibrium diagrams, Solid Solutions, Intermetallic phases. Binary, multicomponents and polyphasic systems.

**Related competencies :**

CE9. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.

CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

**Full-or-part-time:** 22h

Theory classes: 7h

Practical classes: 4h

Self study : 11h

### Chapter II: Diffusion

**Description:**

Diffusion en solid state. Diffusion coefficient. Diffusion equations. Diffusion mechanisms. Diffusion in alloys.

**Related competencies :**

CE9. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.

CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

**Full-or-part-time:** 26h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 4h

Self study : 16h



### Chapter III: Solidification

**Description:**

Solidification. Solidification in metals. Nucleation and growth of crystal from pure metals and alloys. Eutectic Solidification. Ingots Solidification. Metallic glasses. Solidification defects.

**Related competencies :**

CE9. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.

CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

**Full-or-part-time:** 32h

Theory classes: 6h

Practical classes: 3h

Laboratory classes: 4h

Self study : 19h

### Chapter IV: Phase Transformations in solid state

**Description:**

Phase Transformations in solid state. Nucleation and growth of precipitates. Types of precipitates. Espinodal Decomposition. Eutectoid decomposition and discontinuous precipitation. Non equilibrium diagrams (TTT and CCT). Martensitic transformation. Shape-memory alloys.

**Related competencies :**

CE9. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.

CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

**Full-or-part-time:** 41h

Theory classes: 8h

Practical classes: 3h

Laboratory classes: 4h

Self study : 26h

### Chapter V: Microstructural restoration

**Description:**

Recovery. Recrystallization and Grain Growth (normal and abnormal)

**Related competencies :**

CE9. Knowledge of science, technology and materials' chemistry fundamentals. Understanding the relation between microstructure, synthesis or processing and materials' properties.

CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

**Full-or-part-time:** 29h

Theory classes: 5h

Practical classes: 2h

Laboratory classes: 4h

Self study : 18h



## GRADING SYSTEM

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44% Final Exam + 20% Partial Exam + 18 % Practices (Activity 1) + 18% Problems (Activity 2)

THIS SUBJECT HAS NO RE-EVALUATION EXAMS.

## BIBLIOGRAPHY

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### Basic:

- Reed-Hill, Robert E. Physical metallurgy principles. 4th ed. Stamford: Cengage Learning, 2010. ISBN 9780495438519.
- Smallman, R.E.; Bishop R. J. Modern physical metallurgy and materials engineering : science, process, applications. 6th ed. Oxford: Butterworth Heinemann, 1999. ISBN 0750645644.
- Verhoeven, John D. Fundamentals of physical metallurgy. New York: John Wiley and Sons, 1975. ISBN 0471906166.

## RESOURCES

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### Other resources:

Extra docent material will be available at ATENEA digital campus.