Course guide
295707 - MEF - Physical Metallurgy

Last modified: 04/06/2026

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: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JAIRO ALBERTO MUÑOZ BOLAÑOS

Others:

Primer quadrimestre:
CASIMIR CASAS QUESADA - Grup: M21, Grup: M22
JAIRO ALBERTO MUÑOZ BOLAÑOS - Grup: M21, Grup: M22

Segon quadrimestre:
PERE BARRIOBERO VILA - Grup: M11
JAIRO ALBERTO MUÑOZ BOLAÑOS - Grup: M11

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge of science, technology and materials' chemistry fundaments. 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

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

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 thephase 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 fundaments. 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 fundaments. 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 fundaments. 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 fundaments. 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 fundaments. 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

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

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

THIS SUBJECT HAS NO RE-EVALUATION EXAMS.

BIBLIOGRAPHY

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

Other resources:
Extra docent material will be available at ATENEA digital campus.