Course guide
295751 - 295EM021 - Modern Manufacture of Metallic Materials

Last modified: 04/06/2026

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).
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: 2026 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: JOSE MARIA CABRERA MARRERO

Others: Segon quadrimestre:
JOSE MARIA CABRERA MARRERO - Grup: T11, Grup: T12
CASIMIR CASAS QUESADA - Grup: T11, Grup: T12

PRIOR SKILLS

Mechanical behaviour of materials. Microstructural characterisation microestructural of materials

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMCEAM-01. (ENG) Dissenyar i desenvolupar productes, processos i sistemes, això com l'optimització d'altres ja desenvolupats, atenent a la selecció de materials per aplicacions específiques.
CEMCEAM-06. (ENG) Evaluar el tiempo de vida en servicio, la reutilización, la recuperación y el reciclaje de productos atendiendo a las características de los materiales que lo conforman

Transversal:
02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.
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

LEARNING OBJECTIVES OF THE SUBJECT

The general objective of the lecture is to provide the necessary bases to understand the traditional manufacturing processes of metallic materials (casting, rolling, forging, extrusion, drawing, powder metallurgical techniques and welding). The student will also understand the interaction of the different processes with the starting microstructures and those obtained, as well as the correlation with the final mechanical properties. At the end of the course some sessions will be devoted to delineate modern metal forming processes.
The generic competences that the student will achieve will be a) ability to understand how to rationalize the manufacturing process of metal parts, b) ability to develop manufacturing techniques and knowledge of characterization techniques, c) ability to work as a team in the pre-project and d) ability to communicate written and oral technique

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Solidification and Casting

Description:
content english

Specific objectives:
The solidification process. Nucleation and Growth. Types of Growth. The constitutional undercooling. Solidification of binary alloys. Solidification of eutectic alloys.
Solidification in mold. Concept of Castability. Solidification defects.
Molding Feeding and Filling. Molding Rules. Types of Mold

Full-or-part-time: 3h
Theory classes: 3h

Elements of Plasticity Theory

Description:
Stress and types of stresses. Strain and Types of strains. Stress states. Strain states. Modeling of Plastic Deformation. Cold deformation. Hot deformation. Effect of strain rate and emperature. Experimental Tests

Full-or-part-time: 4h
Theory classes: 4h

Introduction to Forming Operations

Description:
Introduction. The Tensile test. Cold vs Hot. Deformation mechanics. SLAB method. Energy Method of Uniform Deformation. The redundant work. Determination of yield stress. Effect of temperature. Effect of strain rate. Effect of friction. Microstructural effects

Full-or-part-time: 4h
Theory classes: 4h

Rolling

Description:
Introduction and historical notes. Hot vs cold rolling. Basic mechanics of rolling. Rolling equipment
Other rolling processes. Problems and defects of rolled products. Thermomechanical control during rolling

Full-or-part-time: 3h
Theory classes: 3h

Forging

Description:
The Forging process. Forging methods. Types of equipment. Forge mechanics. The fiber. Forge defects

Full-or-part-time: 2h
Theory classes: 2h

Extrusion and Drawing

Description:
Definition of Extrusion. Types of Extrusion. Equipment. Extrusion Mechanics. Extrusion matrices. Defectology
Definition of Drawing. Types of Drawing. Drawing dies. Drawing Mechanics. Defects

Full-or-part-time: 2h
Theory classes: 2h

Sheet forming

Description:
Introduction. Materials characteristics for sheet forming processes: strain hardening and anisotropy coefficients. Types of processes. Importance of springback. The drawing process. Defectology. FLD curves. New steels with high yield strength. Hot stamping

Full-or-part-time: 2h
Theory classes: 2h

Welding

Description:
Definition. Physical metallurgy of welding. The thermally affected area. Types of processes. Welidng in solid state. Solid- liquid welding (brazing and soldering). liquid-liquid weldings. Welding by electrical resistance. Oxyacetylene welding. Electric arc welding: coated electrode, TIG, MIG, MAG.
Welding defects. Metallurgical weldability. Weldability in steels.

Full-or-part-time: 2h
Theory classes: 2h

Powder Metallurgy

Description:
Introduction to powder metallurgy. Phases of the Process. The raw material. The compaction. Sintering: in solid phase and in liquid phase. Protection atmospheres. Heat Treatments.

Full-or-part-time: 1h
Theory classes: 1h

New Processes

Description:
Incremental froming: symmetric and asymmetrical. Hydrofroming. Processes of Severe Plastic Deformation

Full-or-part-time: 2h
Theory classes: 2h

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**.

EXAMINATION RULES.

Students can only take a non-programmable calculator to the test. No notes or books are allowed.

BIBLIOGRAPHY

Basic:
- Dieter, George Ellwood. Mechanical metallurgy. 3rd ed. New York [etc.]: McGraw Hill Book Company, cop. 1986. ISBN 0070168938.
- Groover, Mikell P. Fundamentos de manufactura moderna : materiales, procesos y sistemas. México [etc.]: Prentice Hall, 1997. ISBN 9688808466.

Complementary:
- Handbook of metal forming. Dearborn: Society of Manufacturing Engineers, [1994]. ISBN 0872634574.
- Marciniak, Z.; Duncan, J. L.; Hu, S. J. Mechanics of sheet metal forming. 2nd ed. Amsterdam [etc.]: Butterworth-Heinemann, cop. 2002. ISBN 9780750653008.