Course guide
295116 - 295II231 - Advanced Manufacturing

Last modified: 04/06/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.
702 - CEM - Department of Materials Science and Engineering.

Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Optional subject).
ERASMUS MUNDUS MASTER IN SUSTAINABLE SYSTEMS ENGINEERING (EMSSE) (Syllabus 2024). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: RAMON JEREZ MESA - SEYED MAHMOOD FATEMI

Others: Primer quadrimestre:
WALTER CRUPANO - Grup: T1
SEYED MAHMOOD FATEMI - Grup: T1
RAMON JEREZ MESA - Grup: T1

PRIOR SKILLS

Have knowledge about the different groups of materials that can be used to make parts, as well as their properties and how to characterize them.
Please refrain from enrolling students who do not have prior knowledge of manufacturing processes through chip removal, volumetric and sheet plastic deformation and additive manufacturing.

REQUIREMENTS

After completed a degree in engineering from the industrial branch, engineering or degree in physics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMUEII-14. Design and manage production processes that include quality control systems using advanced characterization techniques. (Specific competence of the Advanced Manufacturing Systems specialty).

Generical:
CGMUEII-01. Participate in technological innovation projects in multidisciplinary problems, applying mathematical, analytical, scientific, instrumental, technological and management knowledge.
CGMUEII-05. To communicate hypotheses, procedures and results to specialized and non-specialized audiences in a clear and unambiguous way, both orally and through reports and diagrams, in the context of the development of technical solutions for problems of an interdisciplinary nature.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
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.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

LEARNING RESULTS

Knowledges:
K04. Design and manage advanced manufacturing processes that include quality control systems using advanced characterisation techniques.
K02. Design production and manufacturing systems that ensure responsible and sustainable management of the materials used so that the environmental impact is reduced.

Skills:
S02. Educate well-trained and enthusiastic professionals with broad multidisciplinary knowledge of tools and technologies for sustainable systems engineering. Training takes place in an international and multicultural environment to stimulate global collaboration in addressing complex challenges in a wide range of application fields, such as logistics, transport, advanced production systems, energy systems management and health improvement.

Competences:
C03. Manage the acquisition, organisation, analysis and presentation of data and information in the field of complex systems engineering and critically assess the results obtained.
C05. Propose advanced scientific and technological solutions to complex industrial challenges in areas such as intelligent production, robotic systems, logistics, fault detection and predictive maintenance.
C02. Work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

The course will be developed through theoretical classes of content exhibition, flipped classrooms for some of the contents, laboratory practices and open house sessions in companies and research labs.

LEARNING OBJECTIVES OF THE SUBJECT

The subject aims to transmit to students the ability to:
1. Take decisions on the appropriate techniques to characterize the properties of the products obtained by different processes.
2. Design and manufacture functional parts and / or prototypes based on reverse engineering techniques.
3. Design the manufacturing process and manufacture parts using new non-conventional methods.
4. Use tools to determine the best values for the different parameters that act as variables in a manufacturing process.
5. Analyze the quality of a process based on the functional properties of the manufactured parts.

STUDY LOAD

Type	Hours	Percentage
Hours small group	21,0	14.00
Hours large group	21,0	14.00
Self study	108,0	72.00

Total learning time: 150 h

CONTENTS

Additive manufacturing

Description:
• Additive Manufacturing Techniques (AM).
• Materials used in the- Additive manufacturing of plastics, metals and ceramics.
• Design of the manufacturing process.
• Definition of the different manufacturing parameters.
• Mechanical behavior of materials processed via additive manufacturing.

Specific objectives:
1. Know the different AM techniques available on the market
2. Know the different materials that are used to make pieces for AM
3. Learn to design the manufacturing process of a piece through different AM techniques

Related activities:
Practical sessions in the laboratory for the manufacture of parts with FFF
Visit to the CIM center

Full-or-part-time: 27h
Theory classes: 11h
Laboratory classes: 16h

Plastic deformation processes

Description:
• Moderate and severe plastic forming processes.
• Rotary and incremental process.
• Severe conformation of plastics.

Specific objectives:
1. To learn more about the techniques of forming based on the plastic deformation of the materials.
2. Understand the microstructural evolution of materials subjected to plastic forming.
3. Technological applications of plastic forming.

Full-or-part-time: 9h
Theory classes: 2h
Practical classes: 7h

Advanced characterization of materials techniques

Description:
• Advanced techniques for characterizing the properties of different groups of materials. Microscopes and spectroscopies.
• Advanced techniques for the characterization of dimensional and surface properties of manufactured products.

Specific objectives:
1. Deepening in the knowledge of different techniques used in the characterization of the properties of the different groups of materials used in the manufacture of pieces
2. Increase knowledge about the characterization of dimensional and surface properties of products manufactured by different technologies.

Full-or-part-time: 10h
Theory classes: 4h
Practical classes: 6h

Introduction to the properties of materials

Description:
• Material families and manufacturing.
• Mechanical properties of materials.
• Thermal properties of materials.
• Electrical and magnetic properties of materials.

Specific objectives:
1. Know the different families of materials in engineering and their main uses.
2. Know the different mechanical, thermal and electrical properties of materials in relation to their processing.

Full-or-part-time: 6h
Theory classes: 6h

Optimization and quality control of manufacturing processes

Description:
• Experiment design techniques (DOE).
• Statistical analysis of the results.
• Methods and techniques for modeling the manufacturing processes.

Specific objectives:
1. Learn to use DOE techniques for the conception, realization and analysis of experiments in the manufacture of pieces
2. Introduction to knowledge about other manufacturing process modeling techniques

Full-or-part-time: 8h
Theory classes: 4h
Practical classes: 4h

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**.

The final mark is given over 10. A continuous evaluation system will be followed that includes the following items with the respective relative weights:

Final exam on the whole course - 45 %
Oral presentation on a topic about severe plastic deformation or additive manufacturing processes in metals - 30 %
Hands-on manufacuring of workpiece with technical specifications with FFF - 12.5 %
Programming of CAM routine - 12.5 %

This subject does not have a reassessment test

BIBLIOGRAPHY

Basic:
- Singh Kalsi, Sukhminderbir. Burnishing Of EN-31. Saarbrücken: LAP LAMBERT Academic Publishing, [2015]. ISBN 9783659819858.
- Martín Llorente, Óscar. Problemas resueltos de mecanizado de metales. Valladolid: Ediciones Universidad de Valladolid, [2018]. ISBN 9788484489597.
- Curry, Guy L; Feldman, Richard Martin. Manufacturing systems modeling and analysis [on line]. 2nd ed. Berlin ; Heidelberg: Springer, cop. 2011 [Consultation: 15/04/2020]. Available on: http://dx.doi.org/10.1007/978-3-642-16618-1. ISBN 9783642166181.
- ASM handbook. Vol. 5, Surface engineering. 10th ed. Materials Park, Ohio: ASM International, 1999. ISBN 087170384X.