Course guide
295462 - 295TM113 - Advanced Manufacturing

Last modified: 26/06/2025

Unit in charge: Barcelona East School of Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: MASTER'S DEGREE IN MECHANICAL TECHNOLOGIES (Syllabus 2024). (Optional subject).
MASTER'S DEGREE IN ADVANCED BIOMEDICAL TECHNOLOGIES (Syllabus 2025). (Optional subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Ramón Jerez Mesa

Others: Ramón Jerez Mesa
J. Antonio Travieso Rodríguez
Eric Velázquez Corral

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.

LEARNING RESULTS

Knowledges:
K1. Relate advanced knowledge of biomechanics, biomaterials, implants and prostheses to the design of medical devices.
K3. Relate advanced knowledge of healthcare products and technological innovation concepts.
K.06. Identify the most appropriate techniques, components and materials for the development of advanced applications in mechanical engineering.
K.04. Correctly interpret technical documentation related to the design of facilities, processes and products in the context of research and development projects in the mechanical engineering field.
K.03. Recognise the process and product design principles and methods that apply to smart manufacturing systems.

Skills:
S1. Develop kinematic and dynamic analyses of biomechanical systems using the finite element method.
S9. Plan the stages, tasks and activities involved in designing and developing biomedical devices and sensors or processing biomedical data.
S2. Appropriately use techniques for manufacturing, analysing and characterising biomaterials to choose them correctly and process them according to their properties and potential application.
S.07. Design flexible production/operation systems to improve the performance of industrial processes.
S.03. Use advanced numerical simulation and virtual prototyping techniques to solve complex mechanical problems.
S.01. Comprehensively apply experimental techniques, calculations, evaluations, appraisals, expert reports, studies, work plans and related tasks in the development of mechanical engineering projects, applying compulsory specifications, regulations and standards at each stage of the process.

Competences:
C3. Identify and analyse problems that require making autonomous, informed and reasoned decisions in order to act with social responsibility following ethical values and principles.
C5. Use scientific and technical information to respond to any demand for modification, innovation or improvement of devices, products and processes linked to biomedical engineering for new scientific or technological applications.
C.02. Work as part of a multidisciplinary team, whether as a team member or in a leadership role, to contribute to the development of projects with pragmatism and a sense of responsibility, undertaking commitments with due regard to the resources available.
C.04. Ensure, within the limits of one's professional competence, compliance with ethical standards, professional guidelines and current legislation regarding fundamental rights, taking into account the goal of reducing inequalities, the gender perspective, and the principles of accessibility, inclusion and non-discrimination in the design of technical solutions and in the management of projects and teams.
C.05. Propose advanced scientific and technological solutions to complex industrial challenges in the field of mechanical engineering.

TEACHING METHODOLOGY

The course will be developed through theoretical classes of content exhibition, laboratory practices and open house sessions in companies and research labs.

LEARNING OBJECTIVES OF THE SUBJECT

The course aims to provide students with the skills to:
1. Select the best additive manufacturing process for metals or plastics based on the desired requirements.
2. Autonomously manufacture parts according to technical requirements with FFF printers.
3. Design manufacturing routines using CAM tools, obtain ISO codes for their post-processing and implementation in machine tools.
4. Make decisions on the appropriate techniques to characterize the surface integrity properties of products obtained by different processes.
5. Critically use the different surface texture parameters and measure them.
6. Relate each of the aspects that make up the concept of surface integrity with the impact on the functionality of an engineering part.
7. Design the finishing of parts using processes assisted by ultrasonic vibrations.

STUDY LOAD

Type	Hours	Percentage
Guided activities	6,0	4.00
Self study	102,0	68.00
Hours large group	21,0	14.00
Hours small group	21,0	14.00

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, electronic and computer operation of machines for the manufacture of additives.

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:
Workshop sessions: manufacturing with FFF techniques

Full-or-part-time: 9h
Theory classes: 4h 30m
Laboratory classes: 4h 30m

Subtractive Manufacturing processes

Description:
• Role of CAM within Industry 4.0.
• Requirements to take into account for the design of a manufacturing process with CAM: tool selection, machine programming, part location in the work environment...
• CAM post-processing and ISO code generation for CNC machining.

Specific objectives:
1. Deepen the knowledge of different non-conventional substratum manufacturing processes and their characteristics
2. Learn to evaluate the manufacturing parameters of these processes
3. Know advanced materials to manufacture cutting tools, as well as their characteristics

Related activities:
1. Understand the role that CAM systems play in the industry of the future.
2. Program manufacturing routines with CAM software.
3. Obtain post-processed ISO code for direct import to CNC machines.

Full-or-part-time: 15h
Theory classes: 2h
Laboratory classes: 13h

Surface engineering and surface integrity

Description:
• Surface engineering and its importance for the control of surface integrity of industrial parts.
• 3D texture measurement in engineering surfaces and functional impact.
• Planning of vibration-assisted burnishing processes: parameter selection and expected surface integrity.
• Planning of vibration-assisted machining processes: parameter selection and expected texture.

Specific objectives:
1. Relate the different concepts that integrate the surface integrity of industrial parts with their functional impact in service.
2. Apply and interpret the results obtained from 3D surface texture measurements using advanced parameters contemplated by the regulations and integrate it into the quality assessment process.
3. Know the different vibration-assisted machining processes for super-finishing parts and design them by selecting parameters.
4. Relate manufacturing parameters in vibration-assisted processes with their surface integrity indicators and their functional impact.

Related activities:
Application of processes in the mechanical workshop. Texture measurement with advanced metrology instruments. Talks by experts in the field of industry.

Full-or-part-time: 18h
Theory classes: 9h
Laboratory classes: 9h

GRADING SYSTEM

The final grade is given out of 10. A continuous assessment system will be followed that includes the following items with their respective relative weights:

Activity 1: Design of routine in CAM and execution in the workshop - 25%
Activity 2: Manufacture of parts with a 3D FFF printer according to technical drawing requirements - 25%
Activity 3: Application in the workshop of vibration-assisted machining routines and measurement of the obtained texture - 25%
Final exam of the subject - 25%

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.