

Course guide

340665 - MA3D - 3D Advanced Manufacturing

Last modified: 07/06/2023

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: SERGI MENARGUES MUÑOZ

Others: SERGI MENARGUES MUÑOZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. D50. Knowledge of basic fabrication processes to transform metals, POLIMEROS and ceramics.
2. D51. Ability to identify used machines and its parameters to control in each process.
3. D52. Ability to select, design and optimize more suitable fabrication processes up to design, material, use of the piece and environmental impact.
4. D53. Ability to associate possibilities to design in each fabrication process.

Transversal:

5. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
7. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

- Attending sessions of exposition of contents.
- Attending sessions of practical work (resolution of exercises).
- Attending sessions of practical work in working groups (practices of laboratory).

The professor will introduce the theoretic bases of the matter of the manufacturing processes in the sessions of exposition of contents.

The professor will guide the student in the understanding of the theoretic concepts in the sessions of resolution of exercises, likewise, the oral communication by means of the presentation will be worked up and resolution in public of the proposed problems.

The ability of work in team will develop in the sessions of laboratory.

In the out-class activities the professor supervises the student's work by means of the analysis of his evolution through the evaluation activity and the guided activities.

LEARNING OBJECTIVES OF THE SUBJECT

(ENG)

1. To describe the basics of manufacturing processes for the transformation of metals, polymers and ceramic.
2. To know the dimensional and superficial metrology's basics and its relation in validation and verification of the different processes of manufacture.
3. To identify the utilized machinery and parameters to control the different processes.
4. To select, to design and to optimize the best-suited manufacturing processes in terms of the design, material, use of the part and environmental impact.
5. To correlate the designing possibilities to each manufacturing process.
6. Knowing and designing the management of quality of processes and products.
7. Learning the knowledge about physical properties that they allow defining him the specifications.
8. Applying the methodology of selection of materials and its processes.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

0: Production and sustainability

Description:

- 0.1. Environmental awareness
- 0.2. Material flow and energy
- 0.3. Taxes and pollution

Related activities:

- Activity 1: informative class
- Activity 2: Content's exercises1
- Activity 3: Product and Process Controls practical
- Activity 12: Partial exam 1.
- Activity 25: Final exam.

Related competencies :

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- 07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
- 04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
- 05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 13h

- Theory classes: 4h
- Laboratory classes: 2h
- Guided activities: 0h 30m
- Self study : 6h 30m

1: Product design and quality management.

Description:

1.1 The metrology and measurement systems. Uncertainties of measurement. Systems of management of measures. 1.2. Product design and process selection.

Related activities:

Activity 1: informative class

Activity 2: Content's exercises1

Activity 3: Product and Process Controls practical

Activity 12: Partial exam 1.

Activity 25: Final exam.

Related competencies :

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Full-or-part-time: 13h

Theory classes: 4h

Laboratory classes: 2h

Guided activities: 0h 30m

Self study : 6h 30m

2: Design of components for molding

Description:

2.1. Solidification mechanism. 2.2. Casting materials. 2.3. Design of products for manufacturing: shaping castings design and mould design. 2.4. Major casting techniques. 2.5. High pressure die casting 2.6. Semisolid processes.

Related activities:

Activity 4: informative class

Activity 5: Content' 2 exercises

Activity 6: Aluminium casting practice

Activity 7: Solidification microstructures practice

Activity 12: Partial exam 1.

Activity 25: Final exam.

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05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 20h

Theory classes: 6h

Laboratory classes: 3h

Guided activities: 0h 30m

Self study : 10h 30m

3: Weldability of materials

Description:

- 3.1 Joining processes: welding
- 3.2. Metallurgical phenomena: metals' weldability.
- 3.3. Welding processes.
- 3.4. Adhesives and fasteners

Related activities:

- (ENG) Activity 8: informative class
- Activity 9: Content' 3 exercises
- Activity 10: Welding practice
- Activity 11: Joining microstructures practice
- Activity 12: Partial exam 1
- Activity 25: Final exam

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Full-or-part-time: 25h

- Theory classes: 7h
- Laboratory classes: 3h
- Guided activities: 0h 30m
- Self study : 14h 30m

4: Design of components for plastic deformation

Description:

4.1. The origin, nature and utilisation of plastic flow. 4.2. Temperatures and Processes. Materials formability. 4.3. Rolling. Extrusion. Forging. Bending. Drawing. Superplastic forming.

Related activities:

(ENG) Activity 13: informative class

Activity 14: Content' 4 exercises

Activity 15: Sheet forming practice

Activity 24: Partial exam 2

Activity 25: Final exam

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05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

Full-or-part-time: 24h

Theory classes: 8h

Laboratory classes: 2h

Guided activities: 0h 40m

Self study : 13h 20m

5: Machinability of materials and component design.

Description:

5.1. Shaping by means of chip removal. 5.2. Machinability. 5.3. Nontraditional machining processes. 5.4. Computer-aided manufacturing.

Related activities:

(ENG) Activity 16: informative class

Activity 17: Content' 5 exercises

Activity 18: CNC programming practice

Activity 24: Partial exam 2

Activity 25: Final exam

Related competencies :

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Full-or-part-time: 13h

Theory classes: 3h 30m

Laboratory classes: 2h

Guided activities: 0h 30m

Self study : 7h

6: Design of components for powder metallurgy

Description:

6.1 Powder metallurgy: Design Consideration. 6.2 Surface engineering.

Related activities:

(ENG) Activity 149: informative class

Activity 20: Content' 6 exercises

Activity 24: Partial exam 2

Activity 25: Final exam

Related competencies :

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Full-or-part-time: 11h

Theory classes: 6h

Guided activities: 0h 30m

Self study : 4h 30m

7: Processing of plastics and composites materials

Description:

7.1. Injection Moulding. 7.2. Extrusion. 7.3. Blow Moulding. 7.4. Compression. 7.5. Thermoforming. 7.6. Manufacturing of composites materials.

Related activities:

(ENG) Activity 21: informative class

Activity 22: Content' 7 exercises

Activity 23: Electroplating on plastic practice

Activity 24: Partial exam 2

Activity 25: Final exam

Related competencies :

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Full-or-part-time: 24h

Theory classes: 6h 30m

Laboratory classes: 2h

Guided activities: 0h 45m

Self study : 14h 45m

8. Component design for additive manufacturing

Description:

- 8.1. Design principles
- 8.2. Additive manufacturing technologies
- 8.3. Types of materials and properties

Related activities:

- Activity 1: informative class
- Activity 2: Content's exercises¹
- Activity 3: Product and Process Controls practical
- Activity 12: Partial exam 1.
- Activity 25: Final exam.

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Full-or-part-time: 13h

- Theory classes: 4h
- Laboratory classes: 2h
- Guided activities: 0h 30m
- Self study : 6h 30m

GRADING SYSTEM

The evaluation of the course will become according to the following indicators:

- T, Theory: average mid-term exam 1 and mid-term exam 2.
- P, Solves exercises: Average of the different made exercises.
- L, Practices of laboratory: Weighted average of the different programmed practices.
- F, Final Exam.

The grade of the course will be obtained applying the most favourable one of the following scale:

1. Final grade = $0,6T + 0,1P + 0,3L$

2. Final grade = $0,6F + 0,1P + 0,3L$

The laboratory practices, the tests carried out via Campus Digital and the activities carried out in the classroom during the regular period of classes (problems and / or presentations of work) will not be re-evaluated.

The completion and presentation of the corresponding reports of at least 75% of the laboratory practices will be a necessary condition for the approval of the subject. It will also be a necessary condition to have participated in, at least, 75% of the presentations made in the classroom and to have made the evaluations of them.

BIBLIOGRAPHY

Basic:

- Groover, Mikell P. Principles of modern manufacturing [on line]. 7th. New York: John Wiley & Sons, Incorporated, 2021 [Consultation : 19/03/2024]. Available on : https://search-ebscohost-com.recursos.biblioteca.upc.edu/login.aspx?direct=true&AuthType=ip,uid&db=nlebk&AN=3756146&site=ehost-live&ebv=EB&ppid=pp_C1. ISBN 9781119767022.
- Kalpakjian, Serop; Schmid, Steven R. Manufacturing engineering and technology. 8th ed. Harlow: Pearson Education Limited, 2023. ISBN 9781292422244.
- Ashby, M. F; Johnson, Kara. Materials and design : the art and science of material selection in product design [on line]. 2nd ed. Amsterdam [etc.]: Elsevier Butterworth-Heinemann, 2010 [Consultation: 20/02/2024]. Available on : <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9781856174978/materials-and-design>. ISBN 9781856174978.
- Youssef, Helmi A. Manufacturing technology : materials, processes and equipment [on line]. 2nd ed. Boca Raton, FL: CRC Press, 2023 [Consultation : 20/02/2024]. Available on : <https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9781003373209/manufacturing-technology-helmi-youssef-mahmoud-ahmed-hassan-el-hofy>. ISBN 9781003373209.
- El Wakil, Sherif D. Processes and design for manufacturing. 3rd ed. Boca Raton, FL: CRC Press, 2019. ISBN 9781138581081.
- Ashby, M. F; Ferrer Balas, Dídac; Segalàs, Jordi. Materials and sustainable development [on line]. Waltham, MS: Elsevier, 2015 [Consultation : 20/02/2024]. Available on : <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780081001769/materials-and-sustainable-development>. ISBN 9780081001769.

Complementary:

- Lesko, Jim. Industrial design materials and manufacturing guide [on line]. 2nd ed. New York: John Wiley & Sons, 2008 [Consultation : 14/02/2024]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=818988>. ISBN 9780470055380.
- ASM handbook. Vol. 14, Forming and forging. 9th ed. Metals Park, Ohio: American Society for Metals, 1988. ISBN 9780871700209.
- Seider, Warren D. Product and process design principles : synthesis, analysis, and evaluation [on line]. 4th ed. Hoboken, NJ: John Wiley & Sons, 2017 [Consultation : 21/03/2024]. Available on : https://search-ebscohost-com.recursos.biblioteca.upc.edu/login.aspx?direct=true&AuthType=ip,uid&db=nlebk&AN=1639416&site=ehost-live&ebv=EB&ppid=pp_C1. ISBN 9781119588009.
- Singh, Mrityunjay; Ohji, Tatsuki; Asthana, Rajiv. Green and sustainable manufacturing of advanced material [on line]. Amsterdam, Netherlands: Elsevier Science, 2016 [Consultation: 20/02/2024]. Available on : <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780124114975/green-and-sustainable-manufacturing-of-advanced-material>. ISBN 0-12-411526-8.

RESOURCES

Hyperlink:

- http://www.mit.tut.fi/dictionary/Dic_FrameSet.html. Multilingual dictionary of basic and general terms in metrology
- <http://www.efunda.com/home.cfm>. Online Reference for Engineers
- http://www.sme.org/cgi-bin/getsmepg.pl?communities/education/edu_community_hp.htm&&&SME&. Manufacturing Education & Research Community
- <http://iate.europa.eu/iatediff/switchLang.do?success=mainPage&lang=es>. IATE, Inter-Active Terminology for Europe, is the EU inter-institutional terminology database.