ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

565005802 - Design And Selection Of Materials In 3d Printing

DEGREE PROGRAMME

56DD - Grado Ingenieria En Diseño Industrial Y Desarrollo De Producto

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	565005802 - Design And Selection Of Materials In 3D Printing
No of credits	3 ECTS
Type	Optional/elective
Academic year ot the programme	Fourth year
Semester of tuition	Semester 7
Tuition period	September-January
Tuition languages	English
Degree programme	56DD - Grado Ingenieria en Diseño Industrial y Desarrollo de Producto
Centre	56 - E.T.S. De Ingeniería Y Diseño Industrial
Academic year	2025-26

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Cristina Moreno Diaz (Subject coordinator)	B-150 (1)	cristina.mdiaz@upm.es	Sin horario. Check online

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Computer-Aided Design (CAD)

4. Skills and learning outcomes *

4.1. Skills to be learned

C.11.3. - Conocer el estado actual de las técnicas de impresión 3D así como los criterios para realizar un diseño eficiente con las características y materiales más adecuados a cada proyecto. TIPO: Conocimientos o contenidos.

CE10 - Conocimiento y utilizaciÃ³n de los principios de teorÃa de circuitos y mÃ¡quinas elÃ©ctricas.Nivel: Conocimiento TIPO: Competencias

CE11 - Conocimientos de los fundamentos de la electrÃ³nica.Nivel: Conocimiento TIPO: Competencias

CE12 - Conocimientos y utilizaciÃ³n de los principios bÃ¡sicos del diseÃ±o grÃ¡fico y la comunicaciÃ³n.Nivel: Conocimiento TIPO: Competencias

CE13 - Conocimiento de los principios de teorÃa de mÃ¡quinas y mecanismos.Nivel: Conocimiento TIPO: Competencias

CE15 - Conocimientos básicos de los sistemas de producción y fabricación.Nivel: Conocimiento TIPO: Competencias

CE16 - Conocimientos bÃ¡sicos y aplicaciÃ³n de tecnologÃas medioambientales y sostenibilidad.Nivel: Conocimiento TIPO: Competencias

CE19 - Conocimientos y capacidades para aplicar las técnicas de ingeniería gráfica. Nivel: Conocimiento, análisis y aplicación.TIPO: Competencias

CE23 - Conocimientos y capacidades para aplicar las tÃ©cnicas de ingenierÃa del producto.Nivel: Conocimiento, anÃ¡lisis y aplicaciÃ³n.TIPO: Competencias

CE25 - Conocimientos y capacidades para la aplicaciÃ³n de la ingenierÃa de materiales.Nivel: Conocimiento, anÃ¡lisis y aplicaciÃ³n.TIPO: Competencias

CE27 - Capacidad para realizar individualmente y presentar y defender ante un tribunal universitario un ejercicio consistente en un proyecto en el Ã¡mbito de las tecnologÃas especÃficas de la IngenierÃa en DiseÃ±o Industrial y Desarrollo de Producto, de naturaleza profesional, en el que se sinteticen e integren las competencias adquiridas en las enseÃ±anzas. Nivel: AplicaciÃ³n TIPO: Competencias

CE3 - Conocimientos bÃ¡sicos sobre el uso y programaciÃ³n de los ordenadores, sistemas operativos, bases de datos y programas informÃ¡ticos con aplicaciÃ³n en ingenierÃa.Nivel: AplicaciÃ³n TIPO: Competencias

CE5 - Capacidad de visiÃ³n espacial y conocimiento de las tÃ©cnicas de representaciÃ³n grÃ¡fica, tanto por mÃ©todos tradicionales de geometrÃa mÃ©trica y geometrÃa descriptiva, como mediante las aplicaciones de diseÃ±o asistido por ordenador.Nivel: AplicaciÃ³n TIPO: Competencias

CE6 - Capacidad para conocer, entender y utilizar los principios de EstadÃstica aplicada.Nivel: AplicaciÃ³n TIPO: Competencias

CE9 - Conocimientos de los fundamentos de ciencia, tecnologÃa y quÃmica de materiales. Comprender la relaciÃ³n entre la microestructura, la sÃntesis o procesado y las propiedades de los materiales.Nivel: Conocimiento TIPO: Competencias

CG1 - Conocer y aplicar los conocimientos de ciencias y tecnologÃas bÃ¡sicas.Nivel: Conocimiento TIPO: Competencias

CG10 - Creatividad.Nivel: SÃntesis TIPO: Competencias

CG2 - Poseer la capacidad para diseÃ±ar, desarrollar, implementar, gestionar y mejorar productos, sistemas y procesos, usando tÃ©cnicas analÃticas, computacionales o experimentales apropiadas.Nivel: AplicaciÃ³n TIPO: Competencias

CG3 - Aplicar los conocimientos adquiridos para identificar, formular y resolver problemas en contextos amplios, siendo capaces de integrar los trabajando en equipos multidisciplinares.Nivel: AnÃ¡lisis, SÃntesis TIPO: Competencias

CG4 - Comprender el impacto de la ingenierÃa en el medio ambiente, el desarrollo sostenible de la sociedad y la importancia de trabajar en un entorno profesional y responsable.Nivel: AnÃ¡lisis, SÃntesis TIPO: Competencias

CG5 - Comunicar conocimientos y conclusiones, de forma oral, escrita y grÃ¡fica, a pÃºblicos specializados y no especializados de modo claro y sin ambigÃ¿edades.Nivel: AnÃ¡lisis, SÃntesis TIPO: Competencias

CG6 - Poseer las habilidades de aprendizaje que permitan continuar estudiando a lo largo de toda la vida para un desarrollo profesional adecuado.Nivel: AplicaciÃ³n TIPO: Competencias

CG7 - Incorporar las TIC y las tecnologÃas y herramientas de la IngenierÃa en DiseÃ±o Industrial y Desarrollo de Producto en sus actividades profesionales.Nivel: AplicaciÃ³n TIPO: Competencias

CG8 - Capacidad de trabajar en un entorno bilingÃ¿e (inglÃ©s Â¿ castellano).Nivel: AplicaciÃ³n TIPO: Competencias

CG9 - OrganizaciÃ³n y planificaciÃ³n de proyectos y equipos humanos. Trabajo en equipo y capacidad de liderazgo.Nivel: AplicaciÃ³n TIPO: Competencias

H.13. - Práctica con técnicas aplicables y métodos para resolver problemas complejos, realizar proyectos complejos de ingeniería y llevar a cabo indagación, análisis y síntesis, considerando además sus limitaciones, en el ámbito propio de su especialidad. TIPO: Habilidades o destrezas.

H.14. - Aplicar los materiales, equipos y herramientas, tecnología y procesos de ingeniería y sus limitaciones del ámbito de su especialidad. TIPO: Habilidades o destrezas.

H.9. - Proyectar, diseñar y desarrollar productos complejos (piezas, componentes, productos acabados, etc.), procesos y sistemas de su especialidad, que cumplan con los requisitos establecidos, incluyendo tener conciencia de los aspectos sociales, de salud y seguridad, ambientales, económicos e industriales; así como seleccionar y aplicar métodos de proyecto apropiados, utilizando algún conocimiento de vanguardia cuando sea adecuado. TIPO: Habilidades o destrezas.

4.2. Learning outcomes

RA440 - Los resultados del aprendizaje correspondientes a esta asignatura han quedado definidos en el apartado de competencias de este documento, señalando los que corresponden a conocimientos, habilidades y competencias propiamente dichas.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The attendance and use of this course will allow the student to know the current state of additive manufacturing techniques, as well as the criteria for an efficient design with the most suitable characteristics and materials for each project. In addition, the economic, technical, and environmental implications are assessed.

Through the various sessions, the different points of the syllabus (see point 4.2) will be presented, working in a participatory environment and through mini-projects. During the learning process, students are expected to demonstrate:

- Understanding of techniques, analysis methods, design, and research, as well as materials, equipment, and applicable tools, engineering technologies, and processes, and their limitations in the field of additive manufacturing; the ability to apply engineering practice standards in this field.
- Ability to analyze complex engineering products, processes, and systems within the field of materials and their application in additive manufacturing.
- Application of learned concepts to design with a certain awareness of cutting-edge developments in the field of manufacturing and 3D printing.
- Awareness of the non-technical, social, health and safety, environmental, economic, and industrial implications of the use of certain technologies and materials.
- Demonstrate the ability to effectively communicate information, ideas, problems, and solutions within the engineering community and society at large, as well as operate effectively in a national and international context.

The evaluation methodology will consist of individual tasks and a summary of the sessions attended (40%), presentations (40%), and final project (20%). Attendance is mandatory to obtain (80% attendance).

5.2. Syllabus

1. Introduction to Additive Manufacturing
    1.1. Current state of additive manufacturing technology
    1.2. History and evolution of additive manufacturing
    1.3. Types of additive manufacturing: FDM, SLA, SLS, etc.
2. Efficient Design in Additive Manufacturing
    2.1. Design principles for additive manufacturing
    2.2. Ergonomic and functional considerations in design
3. Material Selection for Additive Manufacturing
    3.1. Types of materials used in additive manufacturing
    3.2. Physical and mechanical properties of materials
    3.3. Material-project compatibility
    3.4. Strength, flexibility, and durability
    3.5. Aesthetic considerations in material selection
4. Economic and Technical Implications
    4.1. Costs associated with different materials and technologies
    4.2. Cost-benefit analysis in material selection
    4.3. Cost optimization strategies in additive manufacturing
5. Environmental Implications
    5.1. Sustainability and recyclability in additive manufacturing
    5.2. Evaluation of environmental impact
6. Practical Case Studies
    6.1. Examples of successful projects in additive manufacturing
    6.2. Challenges and solutions in material selection
    6.3. Presentation and analysis of real projects
7. Future Trends and Technological Developments
    7.1. Current innovations in materials for additive manufacturing
    7.2. Future perspectives of additive manufacturing and its materials

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Module 1: Introduction to Additive Manufacturing** Duration: 02:00 Lecture			
2	**Module 1: Introduction to Additive Manufacturing** Duration: 02:00 Research-based learning			
3	**Module 2: Efficient Design in Additive Manufacturing** Duration: 02:00 Design thinking			
4	**Module 2: Efficient Design in Additive Manufacturing** Duration: 01:00 Design thinking **Presentation 1** Duration: 01:00 Additional activities			**Presentation 1** Group presentation Progressive assessment Presential Duration: 01:00
5	**Module 3: Material Selection for Additive Manufacturing** Duration: 02:00 Research-based learning	**Walk&Talk (W&T)** Duration: 03:00 Additional activities		
6	**Module 3: Material Selection for Additive Manufacturing** Duration: 02:00 Design thinking			
7	**Module 3: Material Selection for Additive Manufacturing** Duration: 02:00 Research-based learning			
8	**Module 3: Material Selection for Additive Manufacturing | Module 4: Economic and Technical Implications** Duration: 02:00 Research-based learning	**Technical Visits CSIC-CNIM** Duration: 03:00 Additional activities		
9	**Module 4: Economic and Technical Implications** Duration: 02:00 Design thinking			

10	**Presentation 2** Duration: 01:00 Additional activities **Module 5: Environmental Implications** Duration: 01:00 Research-based learning			**Presentation 2** Group presentation Progressive assessment Presential Duration: 01:00
11	**Module 5: Environmental Implications | Module 6: Practical Case Studies** Duration: 02:00 Research-based learning			
12	**Module 6: Practical Case Studies** Duration: 02:00 Research-based learning			
13	**Module 7: Future Trends and Technological Developments** Duration: 02:00 Research-based learning			
14	**Final project | FINAL JOINT PROYECT PROTOTIPING** Duration: 02:00 Additional activities			**Final project | FINAL JOINT PROYECT PROTOTIPING** Group work Progressive assessment Presential Duration: 02:00
15				**Class assignments + course participation | individual tasks and a summary of the sessions attended** Other assessment Progressive assessment Presential Duration: 00:00
16				
17				**Presentation** Individual work Global examination Not Presential Duration: 01:00 **Final Exam** Online test Global examination Not Presential Duration: 01:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
4	Presentation 1	Group presentation	Face-to-face	01:00	10%	5 / 10	CG3 CG4 CG5 CG8 CG9 CG10 CE15 CE16 CE19 CE23 CE25
10	Presentation 2	Group presentation	Face-to-face	01:00	10%	5 / 10	CG3 CG4 CG5 CG8 CG9 CG10 CE15 CE16 CE19 CE23 CE25
14	Final project | FINAL JOINT PROYECT PROTOTIPING	Group work	Face-to-face	02:00	40%	5 / 10	CG1 CG2 CG3 CG4 CG5 CG6 CG7 CG8 CG9 CG10 CE1 CE3 CE5 CE6 CE9 CE10 CE11 CE12

							CE13 CE15 CE16 CE19 CE23 CE25 CE27 C.11.3. H.9. H.13. H.14.
15	Class assignments + course participation | individual tasks and a summary of the sessions attended	Other assessment	Face-to-face	00:00	40%	5 / 10	CG3 CG4 CG5 CG8 CG9 CG10 CE15 CE16 CE19 CE23 CE25

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Presentation	Individual work	No Presential	01:00	40%	5 / 10	CG1 CG2 CG3 CG4 CG5 CG6 CG7 CG8 CG9 CG10 CE1 CE3 CE5 CE6 CE9 CE10 CE11 CE12 CE13 CE15 CE16 CE19 CE23 CE25 CE27 C.11.3. H.9.

							H.13. H.14.
17	Final Exam	Online test	No Presential	01:00	60%	5 / 10	CG1 CG2 CG3 CG4 CG5 CG6 CG7 CG8 CG9 CG10 CE1 CE3 CE5 CE6 CE9 CE10 CE11 CE12 CE13 CE15 CE16 CE19 CE23 CE25 CE27 C.11.3. H.9. H.13. H.14.

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final Exam	Online test	Face-to-face	01:00	60%	5 / 10	CG1 CG2 CG3 CG4 CG5 CG6 CG7 CG8 CG9 CG10 CE1 CE3 CE5 CE6 CE9 CE10 CE11 CE12 CE13 CE15 CE16 CE19 CE23 CE25 CE27 C.11.3. H.9. H.13. H.14.
Presentation	Online test	Face-to-face	01:00	40%	5 / 10	CG4 CG7 CE11 CE15 CE16 CE19 CE23 C.11.3. H.14.

7.2. Assessment criteria

The evaluation methodology will consist of individual tasks and a summary of the sessions attended (40%), presentations (20%), and final project (40%). Attendance is mandatory to obtain (80% attendance).

For the extraordinary evaluation, an individual presentation (40%) and written exam (60%) will be assessed.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Lamikiz, A., Camacho, A.M., Ferrández, S. y Batista, M. Fabricación Aditiva, UNED, 2023	Bibliography	
Shahzad, Q.,Umair, M., WAQAR, S.,Bibliographic analysis on 3D printing in the building and construction industry: Printing systems, material properties, challenges, and future trends.Journal of Sustainable Construction Materials and Technologies. 2022	Bibliography	
Gómez González, S., Impresión 3D, Editorial Marcombo, 2021	Bibliography	
Web de publicaciones sobre impresión 3D	Web resource	https://www.3dnatives.com
EELISA	Web resource	https://eelisa.eu
EELISA Community Industrial Design4Human | ID4H	Web resource	https://community.eelisa.eu/communities/indu strialdesign4human-industrial-design-and- innovation-for-sustainable-human-welfare/

9. Other information

9.1. Other information about the subject

Sustainable Development Goals (SDG) Contribution of the course to the following SDG:

- SDG4 - Quality Education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- SDG5 - Gender Equality: Achieve gender equality and empower all women and girls
- SDG9 - Industry, Innovation and Infrastructur.e: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
- SDG11 - Sustainable Cities and Communities Make cities and human settlements inclusive, safe, resilient, and sustainable
- SDG12 - Responsible Consumption and Production: Ensure sustainable consumption and production patterns
- SDG17 - Partnerships to Achieve the Goal: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

This course is part of our INNOVA HUB ETSIDI, Service-Learning, STEAM, and EELISA initiatives and some sessions will be held at this open social innovation and entrepreneurship laboratory/space

New Teaching Methodologies

In addition to lectures and project-based learning, the following active and interdisciplinary methodologies are incorporated:

Walk&Talk (W&T)

An experiential learning methodology that combines thematic walks and collaborative dialogue in public spaces. Its aim is to foster creativity, critical thinking, and contextual awareness in design. Through guided walks, key topics such as energy efficiency, urban planning, spatial transformation, accessibility, and other contemporary social and technological challenges are addressed.

Technical Visits

Visits to companies, technology centers, or third-sector institutions related to social and technological innovation

will be carried out. These experiences connect academic learning with real-world challenges through collaborative listening and prototyping processes. The goal is to strengthen the relationship between university, industry, and society by promoting applied proposals from an interdisciplinary perspective.

Final Joint Project Prototyping

The final project is conceived as a STEAM project (Science, Technology, Engineering, Arts & Mathematics), in which students will develop a functional prototype that integrates the knowledge acquired on materials, efficient design, and sustainability in 3D printing. This project will be developed in multidisciplinary teams and publicly presented as part of the final assessment.