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for **Smart Designers**:
Designers as Innovative TRIggers
for SMEs in the manufacturing sector

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Co-funded by the Erasmus+ Programme of the European Union

DESIGN AND SUSTAINABILITY | syllabus

[Second Semester 2021-2022]

Instructor Information

Instructor	Email	Office Location
Giuseppe Lotti	giuseppe.lotti@unifi.it	Design Campus, Calenzano (FI) - Italy

General Information

Course description

The course will be focused on the interconnection between Design and Sustainability - in its social, environmental and economic declinations - aiming to deepen the following key topics:

- **Design between digital and green transformation: the green perspective** with reference to the ways in which design culture interfaces with issues such as technological innovation and interspecies cooperation
- **Design-driven innovation theory** in relation to the complexity and issues of the 4.0 scenario
- **Strategic design methodologies and tools** in relation to creativity (creative thinking approach)
- **System thinking and systemic design methodologies and tools**, in order to collaborate in innovative ecosystems
- **Design for sustainability** (environmental, socio- cultural, economic) and case studies concerning methods and tools applied
- **Project management methods and tools** in relation to collaborative networks (link with territories and communities, local productive systems, etc.)

Objectives

The objectives of the course aim to provide the participants with:

- **in-depth understanding of the emerging trends in society and economy as driven by the 4.0/5.0 scenario**, with key focus on design-driven innovation paradigm
- application of a **strategic and creative thinking and practice**
- **facilitate system thinking and designing** with a systemic approach (mind set)
- **knowledge about the sustainability paradigm** and how to put it in practice in productive environments (SMEs of the manufacturing sector)

- **facilitate design management**
- **activate design thinking for social innovation** practices
- **soft, digital and green skills together with design methods and tools**.

Methodologies

The learning module and units' methodology is based on an alternation between theoretical lessons and short practical workshops, possibly involving some stakeholders above all companies connected with INTRIDE project.

The structure will consist in **frontal lessons mixed with focus groups and teamwork**, specially when presenting **case studies**. Always involving participants to develop a direct approach with good practices examples presented during the learning units.

Going into more detail, the methodological overview presents:

- **design-driven approach** (strategy-development tools, etc.);
- **codesign and participative approach** (participatory tools, collaborative design framework, cultural probes, etc.) will be used.
- **strategic design process** for business innovation
- **systemic design approach** with methods and tools for supply chain management, SMEs' competitiveness, etc.
- **design thinking process** (Double-Diamond framework, design process diagrams, etc.)

Participants will also be taught how important it is to "manipulate" methods and tools according to the referring design context (including target groups, main objectives and goals, design challenges, etc.).

Course Materials

Tests

During the development of the six learning units of the module, there will be brief moments/tests (short workshops, recap focus groups, etc.) to verify the understanding of the topics addressed. Thus, in order to have a learning environment that is as horizontal, participatory and homogeneous as possible.

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Workshop' details

Design and sustainability: experiments and practices

The final workshop will verify the level of comprehension and assimilation of the contents developed during the learning module. Starting from the first learning units, It will be important to collect feedback from the participants related to their level of understanding of the addressed topics.

The final workshop foresees a full immersion in the theoretical contributions addressed in the previous learning units, together with more intensive insights into the practical laboratory activity. Through an intensive laboratory activity, the perspective is to provide participants with a transversal and cross-level training on the topics of Design for Sustainability. This, together with the aim of providing design methods and tools interconnected with soft, digital and green skills.

Regarding the methodology, a co-design workshop is foreseen using methods, techniques and tools typical of a more participatory approach to design. The participants of the learning module will be at the center of the planned practical activities, with the support of the teachers and tutors involved.

During the workshop, partners from cluster and local companies will be involved, playing an active role in the development of the practical activities expected. They will bring in the workshop context the methodologies and tools that they use in their daily professional experience.

Evaluation process

Final Report 50%	Quality of: The proposal Documentation of Processes & Research Written, Graphical/Audiovisual expression Synthesis and Analysis Application of Feedback Relevant Conclusions
Prototypes 30%	Application of practical knowledge Quality of finishes Oratory and Oral Expression & Specific vocabulary. Application of Feedback
Student Development 20%	Participation and Involvement 20% Self-evaluation / Personal Reflection

Course Schedule

Week	Learning unit's topic	Duration	Credits (ECTS)
Week 1	*Design between digital and green transformation: the green perspective*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 2	*Systemic design for innovative ecosystems*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 3	*Strategic design and creativity*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 4	*Sustainability for manufacturing sector companies*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 5	*Collaborative networks: design as catalyst agent*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 6	*Design thinking for social innovation*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 7	*Design and sustainability: experiments and practices*	50 hours (16 hours in presence of practical work + 34 hours own work)	2 Ects

ECONOMICS, BUSINESS MODEL AND CIRCULAR ECONOMY | syllabus

[Second Semester 2021-2022]

Instructor Information

Instructor	Email	Office Location
Łukasz Wróblewski	lwroblewski@wsb.edu.pl	WSB University - Campus in Cieszyn - Poland

General Information

Course description

The course will be focused on Economics, Business Model and Circular Economy aiming to deepen the following key topics:

- **Circular economy** - oriented towards increase of awareness concerning sustainable sourcing in the production processes under the condition of shrinking availability of virgin materials to be used in the industry
- **Sustainable Logistics** - basics of logistics and the concepts of forward and reverse logistics, as well as managing and improving performance of respective supply chains
- **Heuristic methods** - the significance and weight of individual marketing instruments used by organizations in creative industries in the process of strengthening strategic relationships with different group of stakeholders
- **Strategic partnerships and alliances in creative industries** - recognition of the sense of collaboration in general, especially networking, in the frame of design issues in connection with common learning processes and problem solving
- **Recycling and upcycling** - how to efficiently manage recycling and logistic chains based on current verified solutions and new ideas
- **Innovations by design. Design management in business** - to the role of design in the business organization. Design will be introduced as a tool for business development and creation of not only products, but services, customer's experiences and company's branding

Objectives

- increase of knowledge about the role of relationship marketing and value marketing in process of strengthening strategic relationships with different group of stakeholders
- awareness of the various models of building strategic partnership in creative industries
- increase of knowledge about the role of design in organizations and in creation of innovations
- increase of awareness of the modern trends in planning company's development

Provide the participants with the following issues:

- stakeholders theory and examples of implementation
- network theory and examples of implementation
- quintuple helix model and examples of implementation
- knowledge management and examples of implementation
- examples of collaboration: alliances, partnerships, networks, clusters (especially involved in INTRIDE project)
- advantages and disadvantages of collaboration within the creative industries
- theoretical views on circularity
- legal and political framework for CE
- cradle-to-cradle concept
- examples of circularity in various industries
- stakeholders analysis for CE, multiple helix approach

Methodologies

The structure will consist of frontal lessons mixed with focus groups and teamwork, the main goal of lessons will be focused on exercises and analysis of case studies and best practice, followed by discussion.

Participants will prepare small group case studies based on existing products in real companies.

Going into more detail, the methodological overview presents:

- Lectures with presentation of best practices
- Case studies based learning
- Participatory workshop elements including team work
- Student individual work based on the materials will be gathered on the e-learning platform
- Literature studies

Course Materials

Tests

During the development of the six learning units of the module, there will be specific essays and deliverables, related to each unit, to verify the understanding of the topics addressed.

In each unit a short pre- and post-single-choice test will be held. Each group will give a presentation of the case study.

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Workshop' detalis

Service design as a tool for innovation - The workshop will be dedicated to the ways of facing the challenges connected to the service design and implementation. The course will get an overview on the most important methods and tools of customer experience innovation. It will be focused on the issues connected to the ways of effective improvements of public and business services. Service design tools will be introduced. They will learn to use rapid ethnography, service safari and observations in order to discover the needs of the users. During the two days long workshop students will be provided with theoretical knowledge about the role and stages of the service design process and they will practice teamwork, co-creation and prototyping to find the best solutions for the discovered people's needs. The workshop applies to the skills which should be possessed by the smart designers and innovation leaders in the upcoming era of Industry 5.0.

Regarding the methodology there will be applied methods, techniques and tools related to participatory service design. Students will practice the real process in the Cieszyn city life, they will work with its citizens and local entrepreneurs with the support of tutors involved. Both University and cluster partners will actively participate in the process.

Evaluation process

Final Report 50%	Quality of: The proposal Documentation of Processes & Research Written, Graphical/Audiovisual expression Synthesis and Analysis Application of Feedback Relevant Conclusions
Prototypes 30%	Application of practical knowledge Quality of finishes. Oratory and Oral Expression & Specific vocabulary. Application of Feedback
Student Development	Participation and Involvement 20%

20%	Self-evaluation / Personal Reflection

Course Schedule

Week	Learning unit's topic	Duration	Credits (ECTS)
Week 8	*Circular economy*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 9	*Sustainable Logistics*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 10	*Heuristic methods*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 11	*Strategic partnerships and alliances in creative industries*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 12	*Between recycling and upcycling*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 13	*Innovations by design. Design management in business*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 14	*Service design as a tool for innovation*	50 hours (16 hours in presence of practical work + 34 hours own work)	2 Ects

PRODUCT AND SERVICE DESIGN | syllabus

[Second Semester 2021-2022]

Instructor Information

Instructor	Email	Office Location
Albert Fuster Marti	afuster@elisava.net	ELISAVA Barcelona Campus - Spain

General Information

Course description

This learning module is focused on understanding the current and future contexts and challenges of the Product&Services Industry, with a focus on new materials, emerging contexts, trends and possible design outcomes.

The course will be focused on Service and Product Design, aiming to deepen the following key topics:

- ***Future & Sustainable Trends Research & Analysis*** in relation to future trends analysis with a focus on sustainability
- ***Advanced Design & Creative Methods*** in relation to creative toolkits and their application during the design process
- ***Product-Service Systems*** on their consideration of key innovation aspects during a sustainable Product & Service design process
- ***Technology as a Strategic Force for Change*** in relation to new technologies and materials for sustainability, new paradigms, new manufacturing methods, new artisans
- ***New Paradigms and new strategies for Creative Processes & New Trends in Project Culture*** and in order to conduct research during processes for creative and disruptive environments with a focus on practical workshops

Methodologies

The learning module and units' methodology is based on an alternation between theoretical lessons and short practical workshops, involving some stakeholders such as SME's, Clusters and Technological Centres.

The structure will consist of frontal **lessons mixed with focus groups and teamwork**, specially when presenting **case studies**. Always involving participants

to develop a direct approach with good practice examples presented during the learning units.

Going into more detail, the methodological overview presents:

- **frontal lessons** Students will attend tailored theoretical lectures where the key topics of each module will be addressed by the relevant teaching staff.
- **case study** Students will be asked to perform in-depth analysis of relevant source materials, bibliography and specific instances or projects relevant to the topics of the module, provided to them by the teachers.
- **discussion/Forums** Students will be asked to prepare arguments and actively participate in debates stemming from the topics given in the lessons and case studies.
- **guided demonstrations/workshops** Students will participate in active demonstrations, such as specific use of machinery, hardware or software in order to replicate it and achieve certain results.

Individual or group work will be set depending on the Unit.

Course Materials

Tests

During the development of the six learning units of the module, there will be specific essays and deliverables, related to each unit, to verify the understanding of the topics addressed.

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Workshop' details

Design and sustainability: experiments and practices
The final workshop will verify the level of comprehension and assimilation of the contents developed during the learning module. Starting from the first learning units, It will be important to collect feedback from the participants related to their level of understanding of the addressed topics.
The final workshop foresees a full immersion in the theoretical contributions addressed in the previous learning units, together with more intensive insights into the practical workshop activity. Through an intensive workshop activity, the perspective is to provide participants with a transversal and cross-level training on the topics of Product and Service Design, research and analysis processes related to innovation and sustainability. This, together with the aim of providing design methods, tools and technologies interconnected with soft, digital, design, technological and green skills.
During the workshops, partners from cluster and local companies will be involved, playing an active role in the development of the practical activities expected. They will bring to the workshop their daily professional experience and design context.

Evaluation process

Final Report 50%	Quality of: The proposal Documentation of Processes & Research Written, Graphical/Audiovisual expression Synthesis and Analysis Application of Feedback Relevant Conclusions

Prototypes 30%	Application of practical knowledge Quality of finishes. Oratory and Oral Expression & Specific vocabulary. Application of Feedback
Student Development 20%	Participation and Involvement 20% Self-evaluation / Personal Reflection

Course Schedule

Week	Learning unit's topic	Duration	Credits (ECTS)
Week 15	*Service & Product Design: Future & Sustainable Trends Research & Analysis*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 16	*Design & Creative Methods II*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 17	*Design Stage: New Paradigms for Creative Processes & New Trends in Project Culture*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 18	*Product-Service Systems*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 19	*Technology as a Strategic Force for Change*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 20	*Design Stage: New Strategies for Products & Services*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 21	*Product & Service Design Praxis. Applied Design & Strategies Challenge*	50 hours (16 hours in presence of practical work + 34 hours own work)	2 Ects

CREATIVE EXPLORATIONS OF TRADITIONAL AND DIGITAL TECHNIQUES FOR PRODUCT DESIGN | syllabus

[*not to be piloted during INTRIDE project*]

Instructor Information

Instructor	Email	Office Location
George-Ciprian MIHNEA	ciprian.mihnea@uad.ro	Design Department, UAD Cluj-Napoca - Romania
Octavian SIMION	octavian.simion@uad.ro	Design Department, UAD Cluj-Napoca - Romania

General Information

Course description

The learning module focuses on various issues in design and allows students to pursue individual projects related to the subject of the course.

It aimed at shaping and designing time-based artwork based on analysis of a variety of media.

Students will investigate the diverse applications of digital tools and methods, developing foundational strategies for confident communication. Through research, ideation and production, students will build a comprehensive understanding of the competencies common to digital expression and communicating their professional identity in a digital world.

Topics:

- fine arts and furniture design intersection with digital tools and processes
- design methodologies, tools and techniques in context of IoT
- restoring balance and the possibility of a more constructive and even-handed aesthetic relationship between creative handwork and digital machines work
- developing projects by complex skills in order to understand the real needs of the society in different contexts
- production issues in the context of evolution from low volume production to high volume production
- design ideas adaptation to production technologies in order to release all potential of new technologies
- students' personal investigations aimed at the improvement of the systemic methodology of approaching the product design culture

- learning and applying tools, by keeping the focus on shaping the way of thinking
- developing ways in order to find the solutions for remaining competitive and creative

Objectives

The objectives of the course aim to provide the participants with the following abilities:

- to demonstrate a high level of understanding and knowledge within the field of product design
- to demonstrate skills of efficiently working on a complex theme
- to demonstrate knowledge of the adequate methods for product design
- to evaluate the relation between traditional methods and new technology and to establish which traditions will continue to be valuable
- to demonstrate understanding of both primary and secondary research methods
- to independently work, efficiently using the learning resources
- to develop project management skills in order to enlarge the efficiency in solving the problems
- to demonstrate skills in efficiently communicating the research

Methodologies

The lectures are based on presentations on the computer, individual exercises under supervision, conversation, using resources and critical analysis of the students' exercises.

Presentations offer the students the visual documentary material and the practical experience of analytical review of the main concepts and ideas within the learning unit.

The student's personal investigations aim at improving the systemic methodology of approaching the product design (independent exercises outside the classroom).

Corrections are vital for the design proposition's development, evaluating the quality and the efficiency of the student's work, the capacity to study and monitoring the projects' objectives and results.

Monitoring the results is made by critical individual and group analysis, the compatibility between the concept and the practical solutions, consulting the professors who teach correlated disciplines.

Course Materials

Tests

During the development of the six learning units of the module, there will be specific essays and deliverables, related to each unit, to verify the understanding of the topics addressed.

Bibliography

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Workshop' details

Key contents: Introduction to product testing and certification processes based on valid standards and regulations; On-site tests of furniture; Introduction to life cycle analysis based on the SimaPro software; Modeling and analyzing product life cycles, determination of environmental impact of products; Introduction to rapid prototyping; On-site 3D printing of models, parts or full-scale prototypes.

Evaluation process

Evaluation criteria	Evaluation methods	Percentage within the final grade
Accomplishing the thematic profile	Analysis of the semester works / projects Monitoring the results is made by critical individual and group analysis, the compatibility between the concept and the practical solutions.	30%
Creativity, originality, conceptualization		30%
Technical ability – mastering the media and specific technique of transposition into material		20%
Time invested in the personal research		10%
Communication, the coherence of the design creation approach articulation		10%

Course Schedule

Week	Learning unit's topic	Duration	Credits (ECTS)
Week 22	*Design between digital and green transformation: the digital perspective*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 23	*New computational tools and infrastructures which could be introduced into "traditional" processes of artistic and craft-based production*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 24	*The dynamics of integration of new technological systems and practices into craft and creative design*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 25	*Digital technologies impact into artistic design*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 26	*Innovative thinking through digital media in the field of product design*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 27	*Optimal ideas and practically applied ideas for finding the best solutions in the field of product design using accessible technologies*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 28	*Final workshop "Furniture design for quality and sustainability"*	50 hours (16 hours in presence of practical work + 34 hours own work)	2 Ects

IoT, CLOUD COMPUTING AND CYBER PHYSICAL SYSTEMS | syllabus

[*not to be piloted during INTRIDE project*]

Instructor Information

Instructor	Email	Office Location
Filippo Cavallo	filippo.cavallo@unifi.it	DIEF-UNIFI, Firenze (FI)

General Information

Course description

This learning module aims to provide basic knowledge and methodologies for the design and implementation of advanced IoT, Cloud and robotic solutions in innovative industrial applications, with a focus on theoretical principles, application use-cases and development tools. The following key topics will be addressed:

- ***Internet of Things***, with an overview and fundamental concepts, including standardization and interoperability, IoT framework and applications and future trends
- ***Cloud technologies and architectures*** with the definition of the main properties and concepts, including architectures, platforms and services
- ***Fundamentals and vision of Artificial Intelligence*** with main theoretical concepts behind machine learning, deep learning and algorithms approaches
- ***Cyber physical systems*** with a particular emphasis to robotic design and development, including the main theoretical automation concepts, capabilities and applications;
- ***Designing in the IoT scenario*** with the presentation of design methodologies and tools, supported by hands-on tutorials. There will be explored the connections between design discipline and Internet of Things, specifically related to new products, smart objects and service systems.
- ***Digital communication and digital marketing*** with a focus on business strategies; digital techniques on the organization and promotion of events. It will address the importance of using social media in digital and multichannel communication. Basic elements of marketing, brand management and communication design methods and tools.

Objectives

The objectives of the course aim to provide participants with the following abilities:

- Understand the main concepts of digital transformation, the methods and implications
- Describe the key components and functions of complex systems for industry 4.0
- Identify different system architectures with standardization and interoperability aspects
- Specify, design and develop applications based on the use of sensors, communication modules and robots
- Implement different methods to control motors, power supply and sensors

Methodologies

The course is based on a combination of theoretical and practical frontal lessons that guide the attendants to acquire the main competences for understanding and developing innovative industrial applications. Theoretical lessons provide basic concepts and definitions, but also examples of applications, from the state of art to future perspectives. Practical lessons instruct on the main development tools and methodologies, from the design conceptualization to software programming, providing also hands-on tutorials. The course includes a final workshop, where attendants have to practice on development tools and methodologies learnt during frontal lessons and develop creative project works.

Course Materials

Tests

During the development of the six learning units of the module, there will be brief moments/tests (short workshops, recap focus groups, etc.) to verify the understanding of the topics addressed. Thus, in order to have a learning environment that is as horizontal, participatory and homogeneous as possible.

Bibliography

S. Cirani, G. Ferrari, M. Picone, L. Veltri, *Internet of Things: Architectures, Protocols and Standards*. Wiley, 2018.

O. Vermesan, J. Bacquet, *Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution*. River Publishers, 2017.

Steven L. Brunton and J. Nathan Kutz, *Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control*. Cambridge University Press, 2020.

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Siciliano, Bruno, and Oussama Khatib, eds. *Springer handbook of robotics*. Springer, 2016.

R. Szeliski, *Computer vision, Algorithms and applications*. Springer, 2011.

L. Keviczky, R. Bars, J. Hetthéssy, C. Bányász, *Control Engineering: MATLAB Exercises*. Springer, 2019.

Joseph, Lentin, and Jonathan Cacace. *Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System*. Packt Publishing Ltd, 2018.

Workshop' details

The workshop is conceived to enable attendants to put in practice concepts, methodologies and tools learnt during frontal lessons, perceiving and evaluating in detail their learning path. During the workshop, students are provided with deeper contents on service design and IoT, robotic programing software and assigned with specific project works that reflect the main stakeholders' needs in industry. The use of practical tools is supported by IoT boards and / or robotic simulators for a real and realistic deployment of project works. The expected learning outputs will concern the composition of small prototypes, working samples and demos and / or conceptual mock-ups.

Evaluation process

Final Report 50%	Quality of: The proposal Documentation of Processes & Research Written, Graphical / Audiovisual expression Synthesis and Analysis Application of Feedback Relevant Conclusions
Prototypes 30%	Application of practical knowledge Quality of finishes Oratory and Oral Expression & Specific vocabulary Application of Feedback
Student Development 20%	Participation and Involvement 20% Self-evaluation / Personal Reflection

Course Schedule

Week	Learning unit's topic	Duration	Credits (ECTS)
Week 29	*Internet of Things*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 30	*Cloud Technologies and architectures*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 31	*Fundamentals and vision of Artificial Intelligence*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 32	*Cyber Physical Systems*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 33	*Design and sensor systems*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 34	*Digital communication and digital marketing*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 35	Final workshop *"Digital sense for Design"*	50 hours (16 hours in presence of practical work + 34 hours own work)	2 Ects

ADVANCED FABRICATION MODULE | syllabus

[*not to be piloted during INTRIDE project*]

Instructor Information

Instructor	Email	Office Location
Pere Badalló	pbadalló@leitat.org	LEITAT (DFACTORY), Barcelona - Spain
Xavi Tutó	xtuto@leitat.org	LEITAT (DFACTORY), Barcelona - Spain

General Information

Course description

The course will be oriented to new digital fabrication methods and how the design can be driven in additive manufacturing to obtain new capabilities on design product conception through the following key topics:

- **Digital product development framework** - open design, collaborative networks, Cloud and social manufacturing
- **Co-creation** - digital tools
- **Hybridization conventional and digital technologies**
- **Additive manufacturing technologies** - polymers, metal, and novel technologies

Objectives

The objectives of the course aim to provide the participants with the following abilities:

- To learn and apply the design potentiality of the new paradigm of digital manufacturing
- To demonstrate a high level of understanding on the additive manufacturing techniques available today and the novel technologies available in the coming years

- To acquire knowledge about the relation between traditional manufacturing methods and new digital technology and to establish how merging both for a better design and manufacturing products
- Awareness about the impact of digital manufacturing on the European Green Deal
- To demonstrate the knowledge acquired in digital design for additive manufacturing with different technologies applying the advantages offered by product design
- To enhance the co-creation and collaboration scenarios for an open design practice during the course

Methodologies

The learning module and units' methodology is based on a balance between theoretical and practical lessons and final practical workshops, involving stakeholders such as, Clusters, Universities and Technological Centers.

The order established on Advanced Fabrication module will consist of an initial frontal lesson for an extensive introduction on the additive manufacturing technologies identifying their advantages and disadvantages regarding the traditional manufacturing techniques and using real case studies, how the design can drive and improve the product design in terms of performances, sustainability and cost. Interactive lessons with a participation of students, teachers and stakeholders will be promoted for collaborative work within the course.

The second part of the additive manufacturing module will introduce a practical part of the course. The objective is to promote the collaboration between students in order to solve challenges proposed by stakeholders (SME, large companies, Clusters..) using the awareness acquired in the module using Additive Manufacturing techniques.

Going into more detail, the methodological overview presents:

- **Frontal lessons** Students will attend tailored theoretical lectures where the key topics of each module will be addressed by the relevant teaching staff.
- **Discussion/Forums** Students will be asked to prepare arguments and actively participate in debates stemming from the topics given in the lessons and case studies.
- **Stakeholders challenges** Students will collect challenges for a new product design provided by stakeholders (SME, large companies, Clusters..) and would be select one of them for their final workshop product development.
- **Guided Demonstrations / workshops** Students will participate in active demonstrations, such as specific use of additive manufacturing technologies combined or not with traditional manufacturing methods in order to solve one of the stakeholders challenges.

Course Materials

Tests

During the development of the six learning units of the module, there will be brief moments/tests (short workshops, recap focus groups, etc.) to verify the understanding of the topics addressed. Thus, in order to have a learning environment that is as horizontal, participatory and homogeneous as possible. Moreover, all the short workshops or group exercises will be related with the different addressed manufacturing technologies directly applied to real industrial cases in order to have known similar cases that the students will face in the short future.

Bibliography

Part of the content used during this module will be obtained from the knowledge of LEITAT acquired during its long experience in the R&D projects directly carried out with industrial companies or from international research projects. Moreover, the tight relationship that LEITAT has with the manufacturing technology providers and the continuum use of these technologies in projects is a guarantee to know all the newest advances in different manufacturing technologies and LEITAT will use all this knowledge as a "database" to extract all the module content. The main bibliography used during the course is reported below:

Gibson, I., Rosen, D., Stucker, B., & Khorasani, M. (2020). *Additive Manufacturing Technologies (3.a ed.)*. Springer

Lefteri, C. (2019). *Making It*, Third edition. Laurence King Publishing

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Warnier, C., Verbruggen, D., Ehmann, S., & Klanten, R. (2014). *Printing Things - Visions and essentials for 3D printing*. Gestalten

Anderson, C. (2014). Makers: *The New Industrial Revolution (Illustrated ed.)*. Crown Business

Lipson, H., & Kurman, M. (2013). *Fabricated: The New World of 3D Printing (1.a ed.)*. Wiley

Hudson, J. (2011). *Process: 50 Product Designs from Concept to Manufacture (2.a ed.)*. Laurence King Publishing

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Andrés, P. J. (2009). *Selección de materiales en el proceso de diseño*. CPG EDICIONES

Thompson, R. (2007). *Manufacturing Processes for Design Professionals*. Thames & Hudson

Hague, R., Dickens, P., & Hopkinson, N. (2006). *Rapid Manufacturing: An Industrial Revolution for the Digital Age*. Wiley

Workshop' details

The final workshop will be oriented to evaluate the level of comprehension and assimilation of the contents awareness during the learning module. Specifically, how the design can be used combined with new techniques of additive manufacturing in order to solve the challenges on product design proposed by the stakeholders identified on module.
The use of the potentialities of the digital collaboration environment and their advantages will be especially valued, such as, for example, use of co-creation spaces, generating collaborative environments. Ecological awareness will also be valued throughout the life cycle of the product from the definition of materials, manufacturing methods, uses of the product and final recyclability. This, together with the aim of providing design methods, additive manufacturing technologies interconnected with soft, digital, design, technological and green skills.
During the workshop, partners from cluster and local companies will be involved, playing an active role in the development of the practical activities expected. They will contribute to the evaluation of the practical output of the workshop provided by the students considering the challenges proposed initially.

Evaluation process

Final Report 50%	Quality of: The proposal Documentation of Processes & Research Written, Graphical/Audiovisual expression Synthesis and Analysis Application of Feedback Relevant Conclusions
Prototypes 30%	Application of practical knowledge Quality of finishes

	Oratory and Oral Expression & Specific vocabulary. Application of Feedback
Student Development 20%	Participation and Involvement 20% Self-evaluation / Personal Reflection

Course Schedule

Week	Learning unit's topic	Duration	Credits (ECTS)
Week 36	*Additive manufacturing introduction*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 37	*Additive manufacturing implementation*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 38	*Additive manufacturing technologies I - Polymers*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 39	*Design for additive manufacturing*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 40	*Additive manufacturing technologies II – Metals & Polymers*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 41	*Additive manufacturing technologies III – Others*	25 hours (8 hours in presence + 17 hours own work)	1 Ects
Week 42	Final workshop *"Product development"*	50 hours (16 hours in presence of practical work + 34 hours own work)	2 Ects

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