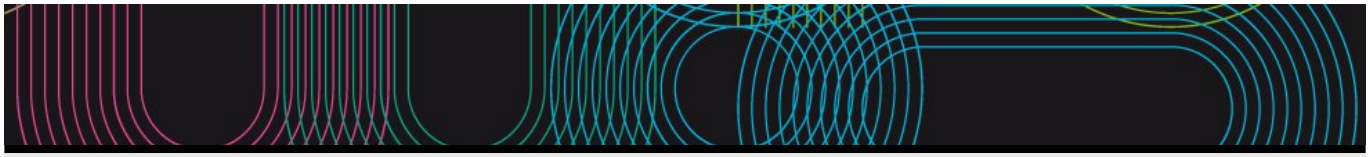

IDENTIFYING DATA				
Simulation applied to design and manufacturing				
Subject	Simulation applied to design and manufacturing			
Code	V04M183V01205			
Study programme	Máster Universitario en Industria 4.0			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Cerqueiro Pequeño, Jorge			
Lecturers	Cerqueiro Pequeño, Jorge Comesaña Campos, Alberto Santos Esterán, David			
E-mail	jcerquei@uvigo.es			
Web	http://masterindustria40.webs7.uvigo.es/wordpress/			
General description	This course aims to train students in the selection of modeling and simulation tools applied to design and manufacturing processes, taking into account the specific circumstances in the Industry 4.0 paradigm framework. The subject will provide students with the experience in the use of different modeling and simulation tools for industrial systems and components, allowing them to analyze their capabilities and limitations, ending with the elaboration of benchmarkings between different solutions and the elaboration of specifications for the selection of an optimal proposal.			

Training and Learning Results	
Code	
A1	Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A3	Students are able to integrate knowledge and deal with the complexity of making judgements based on information which, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgements.
B1	Organization and planning skills
B2	Problem solving.
B7	Computer skills related to the field of study.
C21	To know and be able to use modeling and simulation tools by finite elements, finite differences and computerized fluid dynamics (CFD) as tools of Assisted Engineering (CAE)
C22	Select the appropriate finite element difference (FEM) and computerized fluid dynamics (CFD) modeling and simulation tools to solve design and manufacturing engineering problems
D1	Ability to understand the meaning and application of the gender perspective in different areas of knowledge and in professional practice with the aim of achieving a more just and equal society
D2	Incorporate criteria of sustainability and environmental commitment into professional practice. To acquire skills in the equitable, responsible and efficient use of resources
D3	Multidisciplinary teamwork

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Knowing different modeling and simulation tools such as finite elements (FEM), finite difference (FDM) and computerized fluid dynamics (CFD).	A1 B2 B7 C21 D2
Applying different modeling and simulation techniques such as finite elements (FEM), finite differences (FDM) and computerized fluid dynamics (CFD) as Assisted Engineering (CAE) tools.	A3 B2 B7 C21 D2 D3
Selecting the most appropriate modeling and simulation tools for solving specific design and manufacturing engineering problems in the context of Industry 4.0.	A1 A3 B1 B2 C22 D1 D3

Contents

Topic	
1. Introduction to the simulation of components and processes.	1.1. Models and simulation. 1.2. Tools for the simulation of components. 1.3. Tools for the simulation of processes. 1.4. Symbolic modelling tools.
2. The role of modelling and simulation in Industry 4.0.	2.1. Purposes of modelling and simulation. 2.2. Strategies for modelling and simulation in Industry 4.0.
3. Finite Element Modeling and simulation (FEM).	3.1. Fundamentals and concepts in FEM techniques. 3.2. Applications of FEM tools in Engineering. 3.3. FEM tools for mechanical modelling and simulation. 3.4. Applications of FEM tools in Industry 4.0. 3.5. Selection of FEM tools in Industry 4.0.
4. Finite difference modeling and simulation (FDM): techniques, tools, concepts and applications.	4.1. Fundamentals and concepts in FDM techniques. 4.2. Applications of FDM tools in Engineering. 4.3. FDM tools for modelling and simulation of manufacturing processes. 4.4. Applications of FDM tools in Industry 4.0.
5. Modeling and simulation with computerized fluid dynamics (CFD).	5.1. Fundamentals and concepts in CFD techniques. 5.2. Applications of CFD tools in Engineering. 5.3. CFD tools for mechanical modelling and simulation. 5.4. Applications of CFD tools in Industry 4.0.
6. Selection of modelling and simulation tools for design and manufacture.	6.1. Evaluation modelling and simulation needs in the processes of design and manufacture engineering. 6.2. Performance analysis of modelling and simulation systems. 6.3. Methodology for the selection of modelling and simulation systems. 6.4. Proprietary calculation and simulation tools.
Practical exercise nr 1.	Development of a practical case of multi-technology systems simulation using symbolic modelling tools.
Practical exercise nr. 2.	Elaboration of a FEM study for the detail design engineering stage of an industrial product.
Practical exercise nr. 3.	Elaboration of an FDM study for the manufacturing engineering stage of an industrial product.
Practical exercise nr. 4.	Elaboration of a CFD study for the detail design engineering stage of an industrial product.
Practical exercise nr. 5.	Elaboration of a simulation of a mechanical system using proprietary calculation tools.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	9	16	25
Autonomous problem solving	9	16	25
Practices through ICT	13	32.5	45.5
Project based learning	2	12	14
Objective questions exam	1	0	1
Presentation	1	0	1
Systematic observation	1	0	1

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
	Description
Lecturing	Presentation by the lecturer of the contents on the subject of study, its theoretical bases and/or guidelines of a work or exercise that the student has to develop.
Autonomous problem solving	Activity in which problems and/or exercises related to the subject are formulated. The student must develop the analysis and resolution of the problems and/or exercises in an autonomous way.
Practices through ICT	Activities for the application of knowledge in a given context and the acquisition of basic and procedural skills in relation to the subject through ICT tools.
Project based learning	To carry out activities that allow the cooperation of several subjects and confront the students, working in teams, with open problems. They will allow to hone, among others, the capabilities for cooperative learning, leadership, organization, communication and strengthening of personal relationships.

Personalized assistance	
Methodologies	**Description**
Autonomous problem solving	Activity in which problems and/or exercises related to the subject are formulated. The student must develop the analysis and resolution of the problems and/or exercises in an autonomous way. For all the teaching modalities contemplated in the Contingency Plan, the tutoring sessions may be carried out by telematic means (e-mail, videoconference, FAITIC forums, etc.) under the modality of prior arrangement of virtual place, date and time.
Practices through ICT	Activities for the application of knowledge in a given context and the acquisition of basic and procedural skills in relation to the subject through ICT tools. For all the teaching modalities contemplated in the Contingency Plan, the tutoring sessions may be carried out by telematic means -e-mail, videoconference, FAITIC forums, etc.- under the modality of prior arrangement of virtual place, date and time.
Project based learning	Carrying out activities that allow the cooperation of several subjects so the students confront, working in teams, some open problems. They will allow to train, among others, the capabilities for cooperative learning, leadership, organization, communication and the strengthening of personal relationships. For all the teaching modalities contemplated in the Contingency Plan, the tutoring sessions may be carried out by telematic means -e-mail, videoconference, FAITIC forums, etc.- under the modality of prior arrangement of virtual place, date and time.

Assessment						
	Description	Qualification	Training and Learning Results			
Objective questions exam	Tests composed of objective questions. Mid-term and final objective tests.	40	A1	B1 B7	C21	D2
Presentation	Presentations. Assignments. Projects. Laboratory work reports.	40	A1 A3	B1 B2	C21 C22	D1 D2 D3
Systematic observation	Systematic observation. Complementary activities of continuous assessment.	20	A3	B2		D1 D3

Other comments on the Evaluation

Students who do not pass the subject in continuous training at the first opportunity of each academic year, in which the distribution of evaluation weights is as stablished above, will have the possibility of having an exam of objective questions, worth 100% of the final mark, in successive calls that are not the first opportunity of each academic year.

Ethical commitment: Students are expected to behave ethically. If unethical behaviour is detected (copying, plagiarism, use of unauthorised electronic devices,...), the student will be considered to be ineligible to pass the subject. Depending on the type of unethical behaviour detected, it could be concluded that the student has not reached the necessary skills to overcome the subject. Students are expected to behave in a respectful and dignified manner and to collaborate with the teaching system, teaching staff, coordination and administrative and services personnel of the Master's degree. Any question due to the lack of ethical and dignified behaviour of the student body may have repercussions on the evaluation of the subject.

Sources of information

Basic Bibliography

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Fernández, Mario, **INDUSTRIA 4.0: Tecnologías y Gestión en la Transformación Digital de la Industria**, 1ª, Editor independiente, 2020
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Vásquez Angulo, José Antonio, **Análisis y Diseño de Piezas de Máquinas con CATIA V5**, 1ª, Marcombo, 2008

Complementary Bibliography

Adams, Vince; Askenazi, Abraham, **Building Better Products with FEM**, 1ª, Delmar Cengage Learning, 1998
CADArtifex; Willis, John; Dogra, Sandeep, **SOLIDWORKS Simulation 2019: A Power Guide for Beginners and Intermediate Users**, 3ª, Independently published, 2019
DASSAULT SYSTÈMES, **3DS ACADEMY**, 2020, DASSAULT SYSTÈMES, 2020
Fritzson, Peter, **Introducción al Modelado y Simulación de Sistemas Técnicos y Físicos con Modelica**, 1ª, Wiley-IEEE Press, 2015
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Versteeg, H.K.; Malalasekera, W., **An Introduction to Computational Fluid Dynamics: The Finite Volume Method**, 2ª, Prentice Hall, 2007
Zamani, Nader G., **CATIA V5 FEA Tutorials: Release 21**, SDC Publications, 2012

Recommendations

Other comments

The communication with the students will be made through the MOOVI distance learning platform, for which it will be necessary that the student accesses the course space in the platform previously to the start of the lecturing period.

Before the realisation of the evaluation tests, it is recommended that the students consult with the MOOVI platform to confirm the tests' date, place, recommendations, etc., as well as the needs regarding using manuals or any another material for carrying out the tests and elaborating the home assignment works.