## UniversidadeVigo

Subject Guide 2023 / 2024

IDENTIFYIN					
Simulation	applied to design and manufacturing				
Subject	Simulation applied				
	to design and				
Codo					
Code	V04M183V01205				
programme	Master Universitario en				
programme	Industria 4 0				
Descriptors	FCTS Credits		Choose	Year	Quadmester
Descriptors	4 5		Mandatory	1st	2nd
Teaching	Snanish		Mandatory		2110
language	Galician				
language	English				
Department					
Coordinator	Cerqueiro Pequeño, lorge				
Lecturers	Cerqueiro Pequeño, Jorge				
20000.0.0	Comesaña Campos, Alberto				
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General	This course aims to train students in the se	election of	modeling and sim	ulation tools ap	plied to design and
description	manufacturing processes, taking into acco framework. The subject will provide students with the industrial systems and components, allowi elaboration of benchmarkings between dif	experience ing them to ferent solu	ecific circumstance e in the use of diffe o analyze their cap tions and the elab	es in the Industr rent modeling a abilities and lin pration of speci	y 4.0 paradigm and simulation tools for hitations, ending with the fications for the selection
Training an	of an optimal proposal. d Learning Results				
Code					
A1 Possess applica	s and understand knowledge that provides a tion of ideas, often in a research context	a basis or o	pportunity to be o	riginal in the de	velopment and/or
A3 Student which, applica	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 Organiz	zation and planning skills				
<u>B2</u> Problen	n solving.				
B7 Comput	ter skills related to the field of study.				
C21 To know dynami	1 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 t	he appropriate finite element difference (FE	EM) and co	mputerized fluid d	ynamics (CFD)	modeling and simulation
tools to	solve design and manufacturing engineerir	ng problem	S		
D1 Ability t profess	to understand the meaning and application ional practice with the aim of achieving a m	of the gen ore just ar	der perspective in d equal society	different areas	of knowledge and in
D2 Incorpo	rate criteria of sustainability and environme	ental comm	nitment into profes	sional practice.	To acquire skills in the
equitab	le, responsible and efficient use of resource	25			
D3 Multidis	sciplinary teamwork				
Expected re	esults from this subject				
Expected res	sults from this subject				Training and

Training and Learning Results

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

Contents	
Торіс	
1. Introduction to the simulation of components	1.1. Models and simulation.
and processes.	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	2.1. Purposes of modelling and simulation.
Industry 4.0.	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	<ol><li>4.1. Fundamentals and concepts in FDM techniques.</li></ol>
(FDM): techniques, tools, concepts and	4.2. Applications of FDM tools in Engineering.
applications.	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	5.1. Fundamentals and concepts in CFD techniques.
fluid dynamics (CFD).	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	6.1. Evaluation modelling and simulation needs in the processes of design
design and manufacture.	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	Tr	aining	and Le	arning
			Results			
Objective questions	Tests composed of objective questions. Mid-term and final	40	A1	B1	C21	D2
exam	objective tests.			B7		
Presentation	Presentations. Assignments. Projects. Laboratory work	40	A1	B1	C21	D1
	reports.		A3	B2	C22	D2
						D3
Systematic observation	Systematic observation. Complementary activities of	20	A3	B2		D1
	continuous assessment.					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 ANSYS Inc., ANSYS Fluent Tutorial Guide, Release 2019 R1, 2019 R1, ANSYS Inc., 2018 Fernández, Mario, INDUSTRIA 4.0: Tecnologías y Gestión en la Transformación Digital de la Industria, 1ª, Editor independiente, 2020

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Gunal, Murat M., Simulation for Industry 4.0: Past, Present, and Future, 1ª, Springer, 2019

Lee, Huei-Huang, Finite Element Simulations with ANSYS Workbench 2019, SDC Publications, 2019

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

Law, Averill M., Simulation, modeling and analysis, 5<sup>a</sup>, McGraw-Hill Education, 2015

Tezuka, Akira, Finite Element and Finite Difference Methods, 1ª, Springer, 2006

Ustundag, Alp; Cevikcan, Emre, Industry 4.0: Managing The Digital Transformation, 1<sup>a</sup>, Springer, 2018 Versteeg, H.K.; Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2<sup>a</sup>, 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.