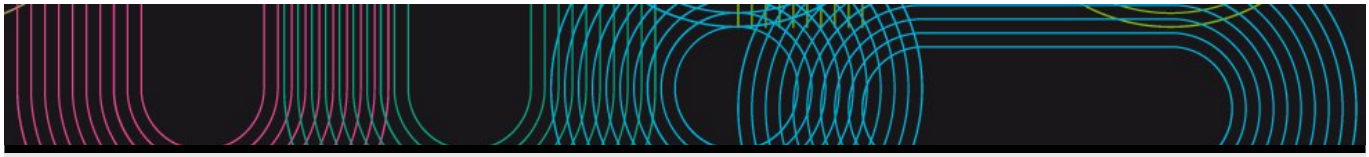

IDENTIFYING DATA				
Simulation applied to plant management				
Subject	Simulation applied to plant management			
Code	V04M183V01108			
Study programme	M.U. Industry 4.0			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Peláez Lourido, Gustavo Carlos Areal Alonso, Juan José			
Lecturers	Areal Alonso, Juan José Peláez Lourido, Gustavo Carlos			
E-mail	jjareal@uvigo.es gupelaez@uvigo.es			
Web	http://masterindustria40.webs7.uvigo.es/wordpress/			
General description	This course deals with one of the most important enabling technologies of the 4.0 industry in the productive field as it is the simulation applied to plant management, from its basic principles to its evolution towards the digital twin and the "virtual commissioning".			

Skills	
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
A2	Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
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.
A4	Students should be able to communicate their findings - and the ultimate knowledge and reasons behind them - to specialist and non-specialist audiences in a clear and unambiguous manner
B1	Organization and planning skills
B2	Problem solving.
B3	Descion making
B4	Information management capacity.
B6	Knowledge and use of the English language.
B7	Computer skills related to the field of study.
C25	Know and be able to use techniques and tools for mathematical modeling and simulation of discrete event systems and dynamic systems for application in production environments.
C26	Apply simulation tools to solve specific problems in plant management and integrate them into the implementation process of the 4.0 paradigms.
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

Learning outcomes	
Expected results from this subject	Training and Learning Results

The student can delimit exactly what the different techniques of modeling and simulation of productive flow are used for within the Manufacturing Plant Control	A1 A2 B1 B3 B4 B6 C25
The student get the necessary skills in the use of plant simulation environments to represent complex systems in scenarios where decision making is not easy.	A2 A3 B1 B3 B4 B6 B7 C25 C26
The student knows how to analyze and choose solutions to shop-floor management problems through simulation studies	A3 A4 B1 B2 B3 B4 B6 C26 D1 D2
The student diagnoses problems and proposes solutions and how these should be integrated in the processes oriented to the implementation of 4.0 paradigms	A2 A3 A4 B1 B3 B4 B6 C26 D1 D2 D3

Contents	
Topic	
Shop-Floor Control	- Components - Support tools
Modelling of Production Systems	- Layouts - Control architectures
General Assigment Resources Problem (GAP) in productive plants	- Levels of decision - forms of solution.
Languages and simulation environments. Applications.	- Languages of Simulation - Simulation Environments - Applications
Examples of development of models and applications on simulation environments	- Development of Models: Examples - Applications on simulation environments: Examples
Integration of plant simulation in the process of evolution towards connected and intelligent factories: Digital Twin & Virtual Manufacturing.	- Representation models associated with each level of manufacturing shop-floor management. - Digital Twin - Virtual Comissioning: Connecting models to the IT of each level. Exposure to different scenarios. Testing to debug or confirm performance.

Planning			
	Class hours	Hours outside the classroom	Total hours
Practices through ICT	14	9	23
Project based learning	4	24	28
Lecturing	4	6	10
Objective questions exam	1	5	6
Project	1	6	7
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
Practices through ICT	Activities of application of knowledge in a given context and acquisition of basic and procedural skills related to the subject, through ICT
Project based learning	Develope activities that allow the cooperation of several subjects and confront the students, working in teams, in open problems. They to allow to train, among others, the capacities of cooperative learning, leadership, organization, communication and strengthening of personal relationships.
Lecturing	Presentation by the teacher of the contents on the subject of study, theoretical bases and/or guidelines of a work, exercise that the student has to develop

Personalized assistance	
Methodologies	**Description**
Practices through ICT	Monitoring and individual evaluation of activities. Even if the activities are carried out autonomously, the students will have tutorial sessions at all times so that the teachers can monitor the activity.
Project based learning	To design a real project that allows the students to deepen their skills. Monitoring and individual evaluation of activities. Even if the activities are carried out autonomously, the students will have tutorial sessions at all times so that the teachers can monitor the activity.
Tests	**Description**
Objective questions exam	Individualized attention to students during the tests. Review of tests and evaluation activities.
Project	Preparation of evaluation activities and evaluation criteria/indicators. Review of evidence and evaluation activities. Communication of results (publication of notes and data and/or review procedure).
Systematic observation	Monitoring and individual evaluation of activities. Even if the activities are carried out autonomously, the students will have tutorial sessions at all times so that the teachers can monitor the activity.

Assessment							
	Description	Qualification	Training and Learning Results				
Project based learning	Objectives: To assess higher thinking skills. Analysis, synthesis and evaluation are valued. The project evaluates knowledge, skills and attitudes	25	A2 A3 A4	B1 B3 B4 B6 B7	C25 C26	D1 D2 D3	
Objective questions exam	Tests that evaluate knowledge that include questions closed with different response alternatives (true/false, multiple choice, matching of elements...). The students choose an answer from a limited number of possibilities (preferably four) with a reduction for failure equal to success probability (-0.25 pts. in the case of four possible answers, if the value of the question is 1 pt). The test of objective questions only evaluates knowledge. Does not assess skills and attitudes. Assesses thinking skills inferior, knowledge, understanding and application.	20	A1 A2 A3	B2 B6 B7	C25 C26		
Project	Objectives: To assess higher thinking skills. Analysis, synthesis and evaluation are valued. The project evaluates knowledge, skills and attitudes	25	A2 A3 A4	B1 B3 B6 B7	C25 C26	D1 D2 D3	
Systematic observation	Careful, rational, planned and systematic perception to describe and record the manifestations of student behaviour. It is possible to assess learning and actions and how they are carried out by evaluating order, precision, skill, efficiency... The aim is to evaluate higher thinking.	30	A1 A2 A3 A4	B1 B3 B4	C26	D1 D2 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 no apt 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, the coordination and the 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

Averill M. Law, **Simulation modeling and analysis**, 978-0-07-340132-4, 5th, McGraw-Hill Education, 2015

W. David Kelton, Jeffrey S. Smith, David T. Sturrock, **Simio and simulation : modeling, analysis, applications**, 9781492116424, 3rd, Simio LLC, 2014

W. David Kelton, Randall P. Sadowski, David T. Sturrock,, **Simulación con software Arena,**, 970-10-6515-8, 4ª, McGraw-Hill interamericana, 2007

Mikel ArmendiaMani GhassempouriErdem OzturkFlavien Peysson, **Twin-Control**, https://doi.org/10.1007/978-3-030-02203-7, Springer, Cham, 2019

Complementary Bibliography

Antoni Guasch ... [et al.], **Modelado y simulación : aplicación a procesos logísticos de fabricación y servicios**, 978-84-8301-704-3, 2ª, UPC, 2003

Altiok, Tayfur; Melamed, Benjamin,, **Simulation modeling and analysis with Arena**, 978-0-12-370523-5, Academic Press, 2007

W. David Kelton, Randall P. Sadowski, Nancy B. Swets,, **Simulation with arena**, 978-1-259-25436-9, 6th, McGraw-Hill, 2015

A. Bauer ... [et al.], **Shop floor control systems : from design to implementation**, 0412581507, Chapman & Hall, 1994

Haruhiko Suwa, Hiroaki Sandoh, **Online Scheduling in Manufacturing**, 9781447145615, Springer London, 2013

Recommendations

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===
In front of the uncertain and unpredictable evolution of the sanitary alert caused by the COVID- 19, the University establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or no totally face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a way but agile and effective when being known in advance (or with a wide in advance) by the students and the faculty through the tool normalised and institutionalised of the educational guides DOCNET.

=== ADAPTATION OF The METHODOLOGIES ===
The educational methodologies will give , to be necessary, adapting them to the telematic means that put the disposal of the faculty, in addition to the documentation facilitated through FAITIC and other platforms, email, etc.
When it was not possible to face-to-face teaching, in the measure of the possible, will prevail the teaching of the theoretical contents by telematic means as well as those contents of practices of resolution of problems, classroom of computing, and others, that can be virtualized developed by the students of way guided, tried keep the attendance presenciality for the experimental practices of laboratory, whenever the groups fulfil with the rule established in the moment by the pertinent authorities in sanitary matter and of security. In the case of not being able to be given of face-to-face form, those contents no virtualizable will give or replace by other (autonomous work guided, etc.) that allow to achieve equally the competitions associated to them.

* Educational methodologies that keep

* educational Methodologies that modify

* Mechanism no face-to-face of attention to the students (tutorials)
The tuitorials will be able to develop indistinctly of face-to-face form (whenever
it was possible to guarantee the sanitary measures) or telematic (email and others) respecting or adapting the schedules of tutorials planned. Besides, it will do an adaptation methodological to the students of risk, facilitating him additional specific information, to accredit that it can not have access to the contents given of conventional form.
* Modifications (proceed) of the contents to give

* additional Bibliography to facilitate to car-learning
Will be able to be added along the course to facilitate the self-learning

* Other modifications

=== ADAPTATION OF The EVALUATION ===
Will keep those proofs that already come making of telematic form and, in the measure of the possible, will keep the face-to-face proofs adapting them to the valid sanitary rule. The proofs will develop of face-to-face form except Rectoral Resolution that indicates they have to do of form non face-to-face, making gave way through the distinct tools put the disposal of the professors. Those no attainable proofs of telematic form will be replaced by other (deliveries of autonomous work guided, etc.)

* Proofs already made
Proof *XX: [previous Weight 00%] [Weight Proposed 00%]
...

* Pending proofs that keep
Proof *XX: [previous Weight 00%] [Weight Proposed 00%]
...

* Proofs that modify
[previous Proof] => [new Proof]

* New proofs
does not proceed
* additional Information
keep the criteria of evaluation adapting the realisation of the proofs, in the case to be necessary and by indication in Rectoral Resolution, to the telematic means put the disposal of the teachers