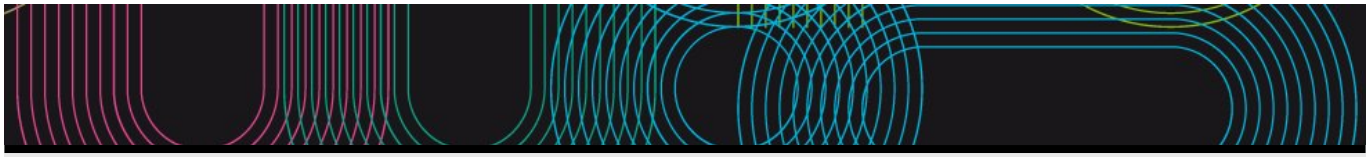

IDENTIFYING DATA				
Advanced calculation tools for engineering				
Subject	Advanced calculation tools for engineering			
Code	V04M183V01112			
Study programme	M.U. Industry 4.0			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Vidal Vázquez, Ricardo Peláez Lourido, Gustavo Carlos			
Lecturers	Karklainen , Tatja Peláez Lourido, Gustavo Carlos Vidal Vázquez, Ricardo			
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General description	More than one million jobs in STEM (Science, Technology, Engineering and Mathematics) profiles will be created in the next four years in Spain, according to estimates by the Spanish Association for Digitalization, DigitalES. The last letter of the acronym is where this subject is headed. Mathematics is a catalyst discipline for the transition to the Fourth Industrial Revolution. They were an essential tool in many fields of the past, are on the present and will be in the future. Maths, in fact, command in some way the ship of the new digital age. And the fact is that, although the main work of mathematics is to make people think, its applications are fundamental in the world of the real and palpable. Therefore, it is important to highlight the importance and role of this discipline in the new era of digitalisation. In this subject we have focused on two main areas of action: - On the one hand, the application of Differential Equations in Engineering, implementation of numerical integration algorithms in mathematical software environments. The application can be made multiple problems, among them those related to manufacturing processes. - On the other hand, the second major application that will study mathematics within the scope of Industry 4.0 is called 'topological data analysis' and deals with how to analyze large data, trying to understand what information can be extracted from a site and the different ways in which the data is shaped. This is a field where Big Data and Machine Learning represent recent fields of great actuality and demand of professionals for the jobs of the future. In this section these techniques will be applied to problems of Industrial Organization such as Resource Allocation or routes.			

Competencies	
Code	
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.
B2	Problem solving.
B4	Information management capacity.
B7	Computer skills related to the field of study.
C31	Know the advanced computer tools for mathematical calculation and their use in design and manufacturing engineering applications
C32	Select and apply advanced calculation tools for solving mathematical problems in the field of design engineering and manufacturing

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

Learning outcomes

Expected results from this subject	Training and Learning Results
The student knows for what, in which tasks and how the advanced software tools of mathematical calculation can be used, in the industrial environment.	A3 B2 B4 B7 C31 D1 D2
The student acquires the necessary skills in the use of advanced mathematical calculation software environments to pose and solve engineering problems in industry.	A2 B2 B7 C31 D1 D2
The student acquires basic and advanced skills in programming languages for scientific use.	A2 B2 B7 C31 C32 D1 D2
The student is able to use programming languages for problem solving in engineering.	A2 B2 B4 B7 C32 D1 D2
El/La estudiante diagnostica problemas y propone soluciones con herramientas de cálculo y cómo se deben integrar estas en los procesos orientados a la implantación de paradigmas 4.0	A2 A3 B4 C32 D1 D2

Contents

Topic	
1.- Differential Equations applied in Engineering	Implementation of numerical integration algorithms of differential equations in mathematical software environments. Application to different types of problems related to manufacturing processes.
2.- Implementation of Algorithms for the Industry 4.0	Study problems in the production organization environment by reviewing algorithms, implementing them and applying them in real situations in the context of Industry 4.0

Planning

	Class hours	Hours outside the classroom	Total hours
Problem solving	9	15	24
Practices through ICT	7.5	7.5	15
Project based learning	2.5	14.5	17
Lecturing	4	6	10
Objective questions exam	0.5	5	5.5
Presentation	0.5	2	2.5
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

Problem solving	Activity in which problems and/or exercises related to the subject are formulated. The student must develop the appropriate solutions by means of the execution of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It is usually used as a complement to a master class.
Practices through ICT	Activities for applying knowledge to specific situations and acquiring basic and procedural skills related to the subject matter. They are developed through ICTs in an autonomous way.
Project based learning	Carrying out activities that allow the interaction of several subjects and train students in teamwork, with open problems. They allow to form, among others, the capacities of learning in cooperation, leadership, organization, communication and strengthening of the interpersonal relations.
Lecturing	Presentation by the teacher of the contents on the subject of study, theoretical bases and/or guidelines of a work, exercise or project to be developed by the student.

Personalized assistance

Methodologies	Description
Problem solving	The teachers propose, guide, review and correct the approach and resolution of problems and/or exercises individually or in groups. Even if the activities are carried out autonomously, the students will have tutorial sessions at all times so that the teachers can control the activity.
Practices through ICT	Develop and provide a script to guide the resolution of the problem or activities. To carry out the follow-up evaluation of the activities. Control 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 control the activity.
Project based learning	Design a real project that allows students to deepen their skills. Control 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 control the activity.
Tests	**Description**
Objective questions exam	Individualized attention to students during the tests. Review of tests and evaluation activities.
Presentation	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). Even if the activities are carried out autonomously, the students will have tutorial sessions at all times so that the teaching staff can monitor the activity.
Systematic observation	Preparation of a list of aspects to be evaluated. Observation of the students.

Assessment

	Description	Qualification	Training and Learning Results
Problem solving	Test in which students must solve a series of problems and/or exercises in a time/conditions established by the teacher. In this way, students must apply the knowledge they have acquired. Different tools can be used to apply this technique such as, for example, chat, mail, forum, audio conference, video conference, etc. Problem solving evaluates knowledge and skills, but not attitudes.	15	A2 B2 C32 B4 B7
Project based learning	Presentation of a project by a group or individually Objectives: To evaluate higher thinking. Analysis, synthesis and evaluation are valued. The project evaluates knowledge, skills and attitudes.	20	A2 B4 C31 D1 A3 B7 C32 D2
Objective questions exam	Tests that evaluate knowledge that include closed questions with different answer alternatives (true/false, multiple choice, matching of elements...). Students select an answer from a limited number of possibilities (preferably four) with a reduction for failure of a value equal to the percentage of success (-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. It does not evaluate skills or attitudes. It evaluates skills of inferior thinking. It assesses knowledge, understanding and application.	20	A2 B7 C31 A3
Presentation	Presentation by the students to the teacher and/or a group of students of an aspect on the contents of the subject or the results of a work, exercise, project... It can be carried out individually or in a group. In the presentation, knowledge, skills and attitudes are evaluated. The objective is to evaluate higher thinking (analysis and synthesis).	15	A2 B4 C31 D1 C32 D2
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 valuing order, precision, dexterity, efficiency... The aim is to evaluate higher thinking.	30	A2 B2 C31 D1 A3 B4 C32 D2 B7

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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Complementary Bibliography

Crouzeix, M., Mignot, A.L., **Analyse Numerique des équations différentielles**, 2-225-81534-8, 2eme. ed. révisée et augm., Masson, 1992

Gekeler, Eckart,, **Mathematical methods for mechanics : a handbook with MATLAB experiments**, 978-3-540-69278-2, 1st, Springer, 2008

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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