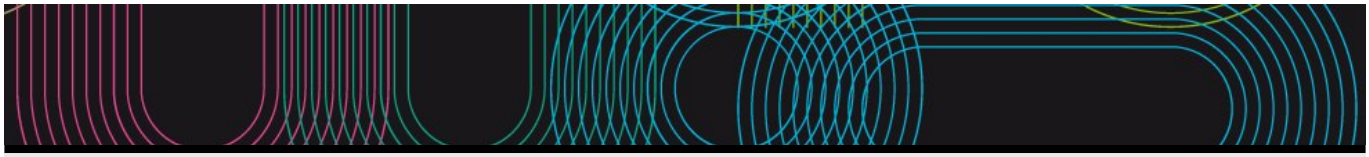

IDENTIFYING DATA				
Numerical calculation				
Subject	Numerical calculation			
Code	O07G410V01941			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Cid Iglesias, María Begoña			
Lecturers	Cid Iglesias, María Begoña			
E-mail	bego@dma.uvigo.es			
Web	http://aero.uvigo.es			
General description	The objective of this subject is that the students know and master different techniques and methods necessary for other subjects as well as for professional practice: the main numerical methods to solve large linear and non-linear systems, initial value and contour problems and the application of the finite element method. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Skills	
Code	
A2	That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
A3	That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues
A5	That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.
B2	Planning, documentation, project management, calculation and manufacturing in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.
C32	Appropriate knowledge applied to engineering: methods of calculation and development of materials and defence systems; management of experimental techniques, equipment and measuring instruments; numerical simulation of the most significant physical-mathematical processes; inspection, quality control and fault detection techniques; their most appropriate methods and repair techniques.
D3	Capability of oral and written communication in native lenguage
D4	Capability of autonomous learning and information management
D5	Capability to solve problems and draw decisions
D6	Capabiliity for interpersonal communication
D8	Capabiliity for critical and self-critical reasoning
D11	Show motivation for quality with sensitivity towards subjects within the scope of the studies

Learning outcomes	
Expected results from this subject	Training and Learning Results

LO1: Knowledge, understanding and application of numerical methods for solving typical Aerospace Technology models and problems.	A2 A3 A5	B2	C32	D3 D4 D5 D6 D8 D11
LO2: Know and use a numerical simulation software tool that uses the finite element method.	A2 A3 A5	B2	C32	D3 D4 D5 D6 D8 D11

Contents	
Topic	
Numerical resolution of big linear systems and non-linear systems	1. Direct methods 2. Methods iterativos. 3. Preconditioners. 4. Methods based in descent algorithms. 5. Methods for non-linear systems.
Methods for initial value and boundary value problems	1. Methods for initial value problems 2. Systems of ordinary differential equations. 3. Methods for boundary value problems.
Finite difference method for partial differential equations	1. FDM for elliptical PDE. 2. FDM for parabolic PDE. 3. FDM for hiperbolic PDE.
Finite element method	1. FEM in one dimension. 2. FEM in higher dimension. 3. FEM for vectorial problems. 4. FEM for evolutionary problems.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	25	60	85
Problem solving	6	12	18
Autonomous problem solving	0	13.5	13.5
Practices through ICT	18	12	30
Essay questions exam	2.5	0	2.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	Activities directed to take contact and gather information on the students, as well as to present the subject.
Lecturing	The professor will expose in the theoretical classes the contents of the matter that illustrate with numerous examples and applications. The students will have basic texts of reference for the follow-up of the subject.
Problem solving	Approach, analysis, resolution and debate of a problem or exercise related with the matter given, so much by part of the educational as of the students. To illustrate and complete the explanation of each lesson and to help to that the student purchase the necessary capacities.
Autonomous problem solving	The student will have to resolve similar exercises to the realised in class to purchase the necessary capacities.
Practices through ICT	They will use computer tools to resolve problems and exercises and apply the knowledges obtained in the classes of theory, and the student will have to resolve similar exercises to purchase the necessary capacities.

Personalized assistance	
Methodologies	**Description**
Problem solving	The professor will attend personally the doubts and queries of the studentes. They will attend doubts in shape face-to-face, especially in the classes of problems and laboratory and in tutorials, as of form no face-to-face, by the available telematic systems for the subject.

Lecturing	The professor will attend personally the doubts and queries of the studentes. They will attend doubts in shape face-to-face, especially in the classes of problems and laboratory and in tutorials, as of form no face-to-face, by the available telematic systems for the subject.
Autonomous problem solving	The professor will attend personally the doubts and queries of the studentes. They will attend doubts in shape face-to-face, especially in the classes of problems and laboratory and in tutorials, as of form no face-to-face, by the available telematic systems for the subject.

Assessment

	Description	Qualification	Training and Learning Results			
Problem solving	Realization in an autonomous way of a collection of problems of each block of contents. LO1	30	A2 A3 A5	B2	C32	D3 D4 D5 D6 D8 D11
Practices through ICT	Assistance and correct realisation of the practices by means of computer programs. LO1, LO2	20	A3 A5	B2	C32	D4 D5 D8
Essay questions exam	Realization of a final exam in which they collect the corresponding contents to the master sessions and to the resolution of problems. LO1	50	A2 A3 A5	B2	C32	D3 D4 D5 D6 D8 D11

Other comments on the Evaluation

In any call it is necessary to obtain 5 points to pass the subject. In order to pass the subject, it is necessary to complete the laboratory practices obtain 5 out of 10 in that practices and obtain a 5 out of 10 in the final exam. In the case of not achieving this minimum in any of the parts, the final mark that will appear in the certificate will be the corresponding one, limited to a maximum of 4.8 points. (*)

The maximum duration of any exam will be 3 hours.

Second chance evaluation (attendees):

The evaluation system for the second call is the same as for the first, with the grades obtained being maintained for practices with computer programs. If the student has not reached a 5 out of 10 in the laboratory practices he/she must take an additional test to pass this part, which represents 20% of the final grade. The exam will be marked out of 10 and will represent 80% of the final qualification. The criteria indicated in (*) will also apply.

Evaluation procedure for non-attendees (any call):

Theoretical and practical assessment: An examination to assess learning outcomes and achievement of the competencies listed in the teacher's guide. Students must achieve a 5 out of 10, rating 80%.

Practical evaluation of computer practices: It is essential to perform this test to pass the subject. It will consist of a practical examination on the topics covered in the computer practices during the course. 5 out of 10 must be obtained to compute with the theoretical part, rating 20%.

The criteria indicated in (*) will also apply.

Evaluation dates:

The evaluation schedule officially approved by the EEAE is published on the website http://aero.uvigo.es/es/docencia/examenes/

It expects that the students present a suitable ethical behaviour. In case to detect an ethical behaviour no suitable (copy, plagiarism, utilisation of electronic devices non authorised, and others) will consider that the/the student/to does not gather the necessary requirements to surpass the subject. In this case the global qualification in the present academic course will be of suspense (0.0).

It remembers the prohibition of the use of mobile devices or portable computers in exercises and practical since the Royal decree 1791/2010, of 30 December, by which approves the Statute of the University Student, establishes in his article

13.2.d), relative to the duties of the university students, the duty of :

"*Abstain of the utilisation or cooperation in fraudulent procedures in the proofs of evaluation, in the works that realise or in official documents of the university*".

Sources of information
Basic Bibliography
Burden, R.; Faires, J., **Análisis Numérico**, Iberoamericana,
Kreyszig, E., **Advanced engineering mathematics**, Wiley,
LeVeque, R.J., **Finite difference methods for ordinary and partial differential equations**, Siam,
Reddy, J. N., **An introduction to the finite element method**, McGraw-Hill,
Complementary Bibliography
Chapra, S., Canale, R., **Métodos numéricos para ingenieros**, McGraw-Hill,
Conde, L.; Winter,G., **Métodos y algoritmos básicos del álgebra numérica**, Reverté,
Grau, J. - Torres, R., **Introducción a la mecánica de fluidos y transferencia de calor con COMSOL Multiphysics**, Addlink,
Quintela,P., **Matemáticas en ingeniería con Matlab**, Universidade de Santiago de Compostela,
Taylor, R.L.; Nithiarasu, P.; Zienkiewicz, O.C., **The finite element method**, Oxford,

Recommendations

Subjects that it is recommended to have taken before
Mathematics: Linear algebra/O07G410V01102
Mathematics: Calculus I/O07G410V01101
Mathematics: Calculus II/O07G410V01201
Mathematics: Mathematical methods/O07G410V01301