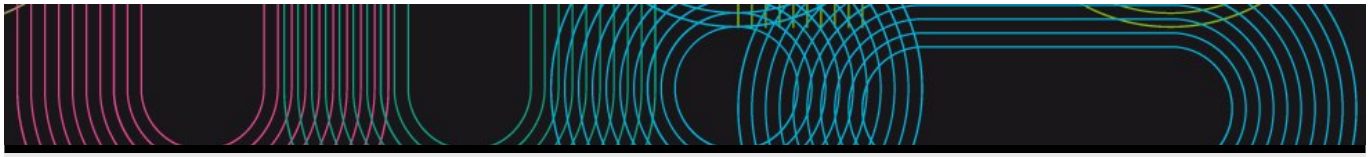

IDENTIFYING DATA				
Aerospace alloys and compound materials				
Subject	Aerospace alloys and compound materials			
Code	O07G410V01942			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Pena Uris, Gloria María			
Lecturers	Pena Uris, Gloria María			
E-mail	gpena@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	This course has to be considered as the continuation of Materials Science and Technology taught in the second year of the degree. In this course we will deepen in the study of the most used materials in the aerospace industry. We will study the light materials (metallic alloys and composite materials) used in the fuselage, wings and stabilizers, as well as the high performance alloys that are used in engines, landing gear and other elements of high responsibility. The most relevant mechanical and surface properties for its application will be presented. Some of the methods used to join materials as well as those used for tensting will be also addressed. English Friendly course: 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.			

Competencies	
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.
C11	Understand the technological benefits, the techniques of optimization of the materials and the modification of their properties through treatments.
C19	Applied knowledge of: science and technology of materials; mechanics and thermodynamics; fluid mechanics; aerodynamics and flight mechanics; navigation and air traffic systems; aerospace technology; theory of structures; airborne transportation; economy and production; projects; environmental impact.
C30	Appropriate knowledge applied to engineering: technological benefits, techniques of optimization of the materials used in the aerospace sector and the processes of treatments to modify their mechanical properties.
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.
C33	Applied knowledge of aerodynamics, flight mechanics, air defense engineering (ballistics, missiles and air systems), space propulsion, material science and technology, structure theory.
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
D8	Capabiliity for critical and self-critical reasoning
D11	Show motivation for quality with sensitivity towards subjects within the scope of the studies
D13	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources

Learning outcomes

Expected results from this subject	Training and Learning Results		
Knowledge, understanding and application of the materials employed in the aerospace sector: capacity to identify his differences.	A3	C11 C19 C30 C33	D4 D8 D11 D13
Knowledge, understanding and application of the materials used in the aerospace sector: tools for the determination of the behaviour and properties.	A3 A5	C11 C32 C33	D4 D5 D8 D11
Knowledge, understanding and application of the materials employed in the aerospace sector: methods of manufacture and optimización.	A2 A3 A5	C11 C19 C32 C33	D3 D4 D5 D11 D13

Contents

Topic	
Lesson 1.- Service performance of metallic alloys	Ductile and brittle fracture. Influence of emperature in fracture processes. Durability.Embrittlement processes. Corrosión and protection methods . Welding technologies: laser, difussion and friction stir welding.
Lesson 2.- Light alloys: Aluminium alloys. Magensium and Berilium alloys	Aluminium alloys: Processing and heat treatments. Classification. Main aluminium alloys for aerospace applications. Magnesium alloys for aerospace applications. Berilium alloy.Main aerospace applications
Lesson 3.- Ultra high strength steels	High resistance stelels: quench and tempering steels. PH Steels. Stainless steels. UHS steels. Maraging. Steels.
Lesson 4.- Titanium Alloys	Introduction to titanium alloys: physical metallurgy and processsing. Properties of titanium alloys.Aerospace applications. Titanium sponge.
Lesson 5.- Superallloys and special alloys.	Ni and Co based Superalloys. Structural intermetallics: titanium, Ni and Fe alluminides. Shape memory Alloys. Superplastic alloys. Aerospace applications.
Lesson 6.- Polymer Matrix Composites	General characteristics. Fibers and Matrix: carbon fibers. Ceramic Fibers (glass, Boron). Organic fibers (aramide, polyethilene), Metallic fibers. Resins (epoxi, poyester, fenolic). Prepregs. Sandwich cores. Thermoplastic matrix. Manufacturing processes. Structural adhesives.
Lesson 7.- Ceramic materials for aerospace	General characteristics. UHT ceramics. Borides, carbides, nitrides. Applications (TBC's, propulsion systems, heatshields). Ceramic matrix composites
Lesson 8.- Materials Selection	Design requirements. Materials for lifting surfaces . Materials for fuselages and propulsion systems. Integration of materials.
Lesson 10.- Quality Control and testing	Raw Materials quality control. Mechanical testing. thermal analysis techniques. Non destructive testing.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	40	120	160
Laboratory practical	14	2.8	16.8
Problem solving	5	2.5	7.5
Case studies	4	20	24
Studies excursion	8	0	8
Objective questions exam	1.5	0	1.5
Problem and/or exercise solving	0.5	0	0.5
Presentation	0.5	3	3.5
Portfolio / dossier	0.5	1.7	2.2

*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	Course presentation. Description of the teaching and evaluation methods. Presentation of the course contents and groups designation.

Lecturing	Teacher explains, clarifies and organizes the main concepts of the lesson, formulating and answering questions, motivating students for further study. Knowledge/skills across the course will be done . by means of an exam according to the official calendar published in web http://aero.uvigo.es/gl/docencia/exame This exam will include objective and short answer questions
Laboratory practical	Activities for the practical application of the acquired knowledge. It is developed in the laboratory and with specialized equipment. They will be evaluated through a practices report
Problem solving	Resolution of problems and exercises related to the subject. Students must be able to solve problems autonomously
Case studies	The teacher makes a proposal of real cases that the student has to analyze, collect information autonomously, individually or in groups with the guidance of the teaching staff. It will be evaluated through a public presentation made to the rest of the students
Studies excursion	Visits in small group made to any of the companies in the aeronautical sector. The student must present a report of the visit made

Personalized assistance

Methodologies	Description
Lecturing	Attention that the teachers individually provide to the students to help them to solve the doubts and difficulties they can find in understanding the contents of the subject.
Case studies	Guidance given by the teacher to the student or group of students to develop the real case that was proposed to solve
Problem solving	Time in which the teacher helps the student to solve the difficulties that can be found in solving problems and practical exercises

Assessment

	Description	Qualification	Training and Learning Results		
Objective questions exam	Written individual exam in which the student will answer solme questions related to the subject presented in the classroom, demonstrating good understanding of the basic concepts, ability to organize the information and to connect concepts	40	A2 A3	C32	D4 D8
Problem and/or exercise solving	Online questionnaires solved through the FAITIC platform, consisting of short questions in which students must show their ability to answer quickly, demonstrating decision-making capacity.	20		C32 C33	D5 D8
Presentation	Oral exam in which the student or a group of students presents the results of the study of a specific case that was formulated by the teachers staff. The summary of the analysis performed, the search for information, study, etc. will be presented on a poster session or the aid of a ppt to their classmates. The information must be well structured, documented and clearly exposed. The defense of the work will be carried out orally, demonstrating the acquired knowledge and its communication abiliity. They must answer the questions by the faculty and the rest of the students	30	A2 A3 A5		D4 D5 D8 D11 D13
Portfolio / dossier	In the portfolio, a compilation is done of the reports or the answer to the questions related to the laboratory practices done, as well as the summary visits to the selected companies. The quality of the information, clarity of exposition and adjustment of the regulations, if applicable, will be assessed.	10	A3 A5	C32 C33	D5 D8 D11 D13

Other comments on the Evaluation

The complete evaluation of the learning process and the skills developed by the student will be carried out through continuous assessment and a final written exam.

*-**Continuous assessment**: Weighing 60% of the total grade, will consist of activities performed throughout the entire semester (Online questionnaires: 20%; Individual or group work: 30%; Portfolio: 10%)*

*- The **written exam** (40%) consists of objective questions, short questions, and test questions. It will be held on the dates set in the evaluation alendar officially approved by the EEAE staff. It is published on the website http: //aero.uvigo.eres/gl/docencia/excursos.*

To pass the course, it will be necessary to achieve a minimum grade of 40% in each one of the assessment types (2.4 / 6 in the continuous assessment and 1.6 / 4 in the written exam). If this criterion is not reached, the maximum grade that the student can achieve is a 4/10.

***Second call exam** (June / July) the student who regularly attends the course, and has passed the continuous assessment,*

will be able to choose between maintaining the grade obtained in these tests and taking only the written exam with a value 40%, or renouncing to the the continuous assessment mark and take an exam that evaluate all the skills, with 100% of the score. This decision must be communicated in the period established by the School or by the teaching staff of th course.

In the case of students who have not attended the course, grading will be based on the mark obtained in a final exam that wiill evaluate the learning outocomes and skills of the course, with 100% of the score.

***Ethical conduct**: As members of the University of Vigo, students are expected to promote an ethical culture and academic integrity. Any attempt to obtain an academic advantage by dishonest or unfair means is considered to be a lack of integrity that is unacceptable.*

In the event the teacher detects unethical behavior by a student (cheating or copy in the written exam through any method, use of electronic devices if not expressly authorized, plagiarism, recycling/resubmitting work...) the student will be graded with FAIL (0,0) in the final grade. I this behaviour is repeated, the facts will be referred to the EEAE director for his consideration.

Sources of information

Basic Bibliography

Ashby, M.; Shercliff, H.; Cebon, D., **Materials. Engieneering, Science, Processing and Design**, 3ª, Elsevier, B.H., 2014

Antonio Miravete, director, **Materiales Compuestos, I y II**, 1ª, Reverté, 2007

Complementary Bibliography

Prasad, N.E.; Wanhill, R.J.H., Editors, **Aerospace MAterials and MAterial Tecnologies, vo:1,2**, 1ª, Springer, 2017

Daniel Gay, **Composite Materials**, 3ª, CRC Press, 2015

F.C, Campbell, **Manufacturing technology for Aerospace Structural Materials**, 1ª, Elsevier, 2006

Augusto Javier de Santos, **Análisis de Fallos en Sistemas Aeronáuticos**, 1ª, Ediciones PAraninfo, 2015

Peter J. Shull, editor, **Nondestructive evaluation**, 1ª, CRC Taylor & Francis, 2002

Recommendations

Subjects that are recommended to be taken simultaneously

Aerodynamics and aeroelasticity/O07G410V01923
Aerospace manufacturing/O07G410V01501

Subjects that it is recommended to have taken before

Chemistry: Chemistry/O07G410V01203
Aerospace technology/O07G410V01205
Materials science and technology/O07G410V01304
Resistance of materials and resilience/O07G410V01405

Other comments

In the event of inconsistency or discrepancy between the different linguistic versions of this publication, the Galician language version shall prevail

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained
All the lecture-based sessions will be maintained, moving them totally or partially to an online version, through the Online Campus (Campus Remoto) of the UVigo.

* Teaching methodologies modified
Laboratory sessions will be modified to adapt the group size to that set by the University or the EEI as safe. Sessions will be organized to ensure the safety distance. All the activities that can be performed in non face-to-face mode will be deployed on online platforms.

In the case of total suspension of face-to-face teaching, alternative activities that allow covering the contents of the practical part of the subject will be provided: virtual tools, videos, etc.
- The defense of the work considered in the continuous assessment will be carried out preferably face-to-face. If this is not possible, it will be performed through the Virtual Campus

* Non-attendance mechanisms for student attention (tutoring)
Non-face-to-face tutorial services will be held through the virtual offices on the Virtual Campus, expanding the office-hours to encourage student participation. Student attention may be carried out also by other ways (email, videoconference, FAITIC forums, ...), always after previous agreement with the teacher.

* Modifications (if applicable) of the contents
According to the moment when the University decision of starting non-face-to face or mix teaching is made, modification in the lab contents will need to be done, following the defined organization. Students will be informed of the changes through FAITIC platform (see Adaptation of Assessment section)

* Additional bibliography to facilitate self-learning
Althoug additional bilbiography is already indicated at the end of each lesson, if student access to academic libraries is limited, additional documentation will be provided.

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
The marks obtained in the continuous assessment tests already performed will maintain their weight in the final grade without changes, as defined in the teaching guide.

* Pending tests that are maintained
Those continuous assessment tests or exams that have not yet been done will also maintain their contribution in the final grade, as defined in the teaching guide.

* Tests that are modified
Despite the change in the fase-to-face/virtuallity of the assessment exams, the weight in the course grade indicated in the teaching guide will not change, except in the exceptional situation in which none of the lab sessions, or visits to the aeronautical companies coudl be carried out.
In this case, as the substitute activities will involve a greater workload on the part of the students, will be taken into account with 20% of the grade at the expense of areduction in the weight of the written exam from 40% to 30%.

* New tests
In the exceptional case indicated above, a new online test will be carried out to assess the knowledge acquired in the activities that substitute lab sessions. This new test, that replace the portfolio, will consist of short questions and exercises and will be valued with 20%.

* Additional Information
In any case, the requirement of achieving a minimum mark of 40% in both the continuous assessment and the written exam remains the same.