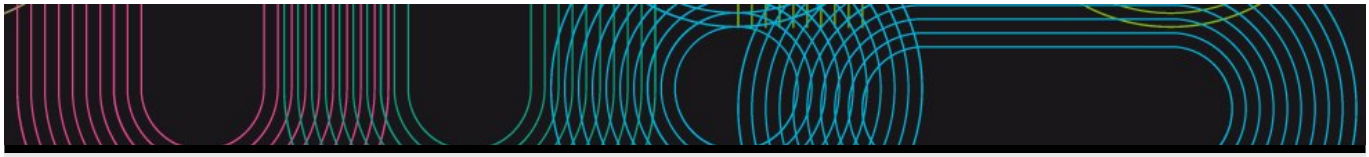

IDENTIFYING DATA				
Aerospace alloys and compound materials				
Subject	Aerospace alloys and compound materials			
Code	O07G410V01942			
Study programme	Grado en Ingeniería Aeroespacial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	3rd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Álvarez González, David			
Lecturers	Álvarez González, David			
E-mail	davidag@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.			

Training and Learning Results	
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

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.- General characteristics of materials used in the aerospace industry	Design requirements, accreditation and certification of evolution two materiais
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. Metal matrix composites
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. Fibre Metal Laminate (FML) 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	Introduction to the material selection process. Ashby method (CES Edupack). Material selection maps.

Planning	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	46	115.5	161.5
Mentored work	1	20	21
Studies excursion	8	0	8
Laboratory practical	14	2	16
Problem solving	5	5	10
Objective questions exam	2	0	2
Presentation	0.5	3	3.5
Portfolio / dossier	1	1	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
Mentored work	Students will develop a work in small groups, selecting the topic among those proposed by the teacher. This activity will be evaluated through the public defense of work, using previously known criteria
Studies excursion	Visits in small group made to any of the companies in the aeronautical sector. If visits are not possible, they will be replaced by lectures given by specialists in the sector. The students must present a report of the visit made that will be included in their dossier
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. They will be evaluated through the autonomous resolution of proposed exercises that will be incorporated into the student's dossier

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.
Laboratory practical	Individual attention to the students to help them to solve the difficulties in the development of laboratory classes
Problem solving	Time in which the teacher helps the student to solve the difficulties that can be found in solving problems and practical exercises
Mentored work	Individual attention for helping students to develope the group work

Assessment

	Description	Qualification	Training and Learning Results		
Problem solving	Throughout the course, students will carry out a series of online questionnaires in which, through multiple choice questions and solving exercises, they must show their understanding of the basic concepts and their rapid application to problems related to the aeronautical materials	10	A2 A5	C30	D4 D8
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
Presentation	Oral exam in which the students present to the teachers and the classmates the work developed in small groups Students shuld demonstrate the acquired knowledge and its communication abiliity. They must answer the questions by the teahcer and the rest of the students. the evaluation will follow previously known criteria	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.	20	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: 10%; Individual or group work: 30%; Portfolio: 20%).Face-to-face presentation will be held during school hours*

*- 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 30% in each one of the assessment types. 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. The same nethodology will be applied in the end of program call.*

The student has the right to opt for the exam -only assesment according to the procedure and the deadline established by the centre for each call.

***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

Peter Morgan, **Carbon fibers and their composites**, 1ª, Taylor &Francis, 2005

Recommendations

Subjects that continue the syllabus

Materials for the aerospace industry/O07G410V01903

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