

(*)Escola de Enxeñaría Aeronáutica e do Espazo

Presentation

The School of Aeronautic and Space Engineering (EEAE) of the University of Vigo at the Campus of Ourense offers the degrees of the University of Vigo that are related both to bachelor's and to master's level in the field of aeronautical or aerospace engineering.

More information about the Center and its degrees is found in this document or on the web page (http://aero.uvigo.es).

Address

Escola de Enxeñaría Aeronáutica e do Espazo

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Regulations and legislation

The information is available on the Center's web site (http://aero.uvigo.es in the section: School -> Regulations).

(*)Máster Universitario en Enxeñería Aeronáutica

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
O07M197V01101	Advanced aerodynamics and aeroelasticity	1st	6
O07M197V01102	Advanced aerospace materials and production	1st	9
O07M197V01103	Design, calculation and certification of aircraft and space vehicles	1st	9
O07M197V01104	Advanced fluid mechanics	1st	6
O07M197V01201	Flight Dynamic	2nd	6
O07M197V01202	Advanced calculation of aerospace structures	2nd	6
O07M197V01203	Design, calculation and certification of aerospace propulsion systems	2nd	6

O07M197V01204	Advanced air navigation systems	2nd	6
O07M197V01205	Avionics	2nd	6

Year 2nd

Code	Name	Quadmester	Total Cr.
O07M197V01301	Management of Spatial Processes	1st	6
O07M197V01302	Space environment and mission analysis	1st	6
O07M197V01303	Space mechanical, thermal and electrical systems	1st	6
O07M197V01304	Critical software for space systems	1st	6
O07M197V01305	Space telecommunication systems	1st	6
O07M197V01306	Space Observation Systems	1st	6
O07M197V01307	Space sciences	1st	6
O07M197V01308	Orbit and Attitude Control Systems	1st	6
O07M197V01309	Space propulsion	1st	6
O07M197V01310	Artificial Intelligence in Space Engineering	1st	6
O07M197V01401	Operation of air transport	2nd	6
O07M197V01402	Development of aeronautical infrastructures	2nd	6
O07M197V01403	External practices	2nd	6
O07M197V01404	Final Master's Project	2nd	12

Year 1st

Code	Name	Quadmester	Total Cr.
O07M197V01921	Solid mechanics and aerospace structures	1st	9
O07M197V01922	Fluid mechanics II and CFD	1st	9
O07M197V01923	Aerodynamics and aeroelasticity	2nd	9
O07M197V01924	Mechanics of flight	1st	6
O07M197V01933	Space vehicles	2nd	6

IDENTIFYING DATA

Advanced aerodynamics and aeroelasticity

Subject	Advanced aerodynamics and aeroelasticity			
Code	O07M197V01101			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	García Luis, Uxía			
Lecturers	Castro Álvarez, Óscar			
E-mail	uxia.garcia.luis@uvigo.gal			
Web	http://webs.uvigo.es/muea			
General description	The subject of "advanced aerodynamics and aeroelasticidad" deepens in in the methods of calculation of the aerodynamic and aeroelastic loads that a fluid exerts on aerodynamic, slender and blunt bodies in distinct ranges of aircraft flight. It deepens also in the aerodynamic phenomena in subsonic, transonic, supersonic and hypersonic flight of aircraft or other vehicles, and in static and dynamic aeroelastic phenomena.			

Training and Learning Results

Code	
B2	Understanding and mastering the laws of external aerodynamics in different flight regimes, and application to numerical and experimental aerodynamics
C1	Ability to design, execute and analyze ground and flight tests of aerospace vehicles, and to carry out a complete aerospace vehicle certification process.
D2	Application of knowledge acquired in different disciplines to solve complex aeroelasticity problems
D5	Understanding and mastery of the laws of internal aerodynamics, as well as their application, together with other disciplines, to the resolution of complex aeroelasticity and propulsive systems problems.

Expected results from this subject

Expected results from this subject	Training and Learning Results
ID3. Understanding and mastery of the laws of external aerodynamics in the different flight regimes, and application to numerical aerodynamics and experimental.	B2
ID4. Application of the knowledge acquired in different disciplines to the resolution of complex aeroelasticity problems.	D2
ID9. Ability to design, execute and analyze ground and flight tests of aerospace vehicles, and to carry out a process of complete certification.	C1
ID14. Understanding and mastery of the laws of internal aerodynamics, as well as application together with other disciplines, to the resolution of complex problems of aeroelasticity and propulsion systems	D5

Contents

Topic	
1. Subsonic aerodynamics	o Potential theory of wings in a subsonic compressible regime. o Subsonic and supersonic air intakes. o Numerical techniques of whirlwind methods. o Experimental techniques (wind tunnels, instrumentation and test techniques).
2. Supersonic and hypersonic aerodynamics	o Transonic phenomena in profiles and wings. o Supersonic wing power theory. o Potential theory of slender bodies. o Subsonic and supersonic air intakes. o Hypersonic regime
3. Static aeroelasticity and vibrations	o Continuous systems and discrete systems. Forced vibrations of continuous systems. o Approximate methods for solving continuous systems. Static aeroelasticity of the wings. Divergence and control reversal.

4. Dynamic aeroelasticity	o Dynamic aeroelasticity of wings. o Advanced aeroelasticity. Aeroelasticity in the Laplace domain. Nonlinear aeroelasticity. Aeroservoelasticity. o Structural dynamics and aeroelasticity tests. Aeroelastic tests in flight.

Planning

	Class hours	Hours outside the classroom	Total hours
Case studies	12	62	74
Lecturing	29	0	29
Problem solving	4.5	0	4.5
Autonomous problem solving	0	10	10
Previous studies	0	30	30
Essay questions exam	1.5	0	1.5
Presentation	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
Case studies	Realization of practical case studies on the contents of the subject, which will be explained and started in the classroom to be finished autonomously and submitted by the students afterwards. The case studies will require the use of software and/or the wind tunnel.
Lecturing	Presentation of a topic or resolution of problems by the teaching staff according to a previously established script.
Problem solving	Resolution of problems and/or exercises that deal with specific aspects of the contents of the subject, developed by the teaching staff and/or the students in the classroom
Autonomous problem solving	Resolution of problems and/or exercises that deal with specific aspects of the contents of the subject, developed by the students outside the classroom
Previous studies	Students study autonomously, with the support of the teaching staff if required according to the procedures established by the university for tutorials

Personalized assistance

Methodologies	Description
Case studies	Realization of practical case studies on the contents of the subject, which will be explained and started in the classroom to be finished and delivered by the students outside the classroom. The students will have the necessary tutorials with the teaching staff to monitor the development of the case studies.
Previous studies	Support tutorials for students to study independently, according to the procedures established by the university.

Assessment

	Description	Qualification	Training and Learning Results		
Case studies	Case studies to be analysed throughout the semester, distributed over time, using several software tools for their implementation.	40	B2	C1	D2 D5
Essay questions exam	Exam based on problem-solving and/or conceptual questions related to the course content. It will take place on the official exam date.	40	B2	C1	D2 D5
Presentation	Presentations of the results of the case studies to be carried out by the students throughout the course.	20	B2	C1	D2 D5

Other comments on the Evaluation

First Call *(1) Students following the course through Continuous Evaluation*

To pass the course in the first call via Continuous Evaluation, the following conditionsmust be met: - A minimum grade of 4 out of 10 in each of the assessable tasks of the subject (case studies, each of the blocks tested in the essay-question exam, and the presentation).- Attendance to at least 90% of the practical sessions. If these conditions are not met, the final grade will be the minimum between the weighted average of Continuous Evaluation and 4.9.

(2) Students opting for Global Evaluation

By default, the course will be evaluated through Continuous Evaluation in the first call. However, students have the right to opt for Global Evaluation, following the procedure and deadlines established by the center for each examination period. The grade obtained in this exam will account for 100% of the final grade. A minimum score of 5.0 out of 10 is required to pass. This exam may include a section to be carried out in a computer room and/or laboratory and will cover the entirety of the course content, including practical sessions and assignments.

Second Call and End-of-Studies Call
Students who do not pass the course in the first call may take an exam that will account for 100% of the final grade. A minimum score of 5.0 out of 10 is required to pass. This exam may include a section to be conducted in a computer room and/or laboratory and will cover the full content of the course, including all practical sessions and assignments.
Regarding the subject blocks The theoretical blocks of the subject are understood as the competencies related to Block 1 on aerodynamics (subsonic, supersonic, and hypersonic regimes) and Block 2 on aeroelasticity (static, vibrations and dynamic).

About the use of Artificial Intelligence

The use of AI tools is permitted as support in the development of the assessable tasks of the subject (except in exams with essay questions). However, students must be fully aware of their learning process and responsible for the submitted content. The use of AI for the complete generation of content or the impersonation of authorship will be considered academic fraud. In the presence of well-founded indications of improper AI use, the teaching staff may reject the assignments, request additional evidence, or refer the case to the corresponding disciplinary procedure.

About the use of electronic devices

During the tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic devices is not permitted in the classroom, except for those expressly authorized by the school administration for medical reasons, according to the resolution corresponding to the request for students with special educational needs. During the tests, all students must keep their ears uncovered to ensure they are not using unauthorized devices. If any student is found with unauthorized material during any test, whether copying, attempting to copy, or simply possessing the material in the classroom, it will be grounds for disciplinary action. After identification, the student will be asked to leave the classroom, and their final grade will be 0 points.

Sources of information

Basic Bibliography

Bertin, J.J. and Cummings R.M., **Aerodynamics for engineers**, 6, Pearson Prentice-Hall, 2014

A. Barrero Ripoll, **Aerodinámica de altas velocidades**, Garceta Grupo Editorial, 2011

Vos, R. and Farokhi, S., **Introduction to Transonic Aerodynamics**, 978-94-017-9746-7, Springer, 2015

Wright, J.R. and Cooper, J.E., **Introduction to Aircraft Aeroelasticity and Loads**, 978-1-118-48801-0, 2, John Wiley & Sons Ltd., 2014

Complementary Bibliography

Anderson, J., **Fundamentals of Aerodynamics**, 6, McGraw-Hill, 2017

Recommendations

Subjects that continue the syllabus

Flight Dynamic/O07M197V01201

Subjects that are recommended to be taken simultaneously

Advanced fluid mechanics/O07M197V01104

Subjects that it is recommended to have taken before

Aerodynamics and aeroelasticity/O07M197V01923

IDENTIFYING DATA

Materiais e producción aeroespacial avanzados

Subject	Materiais e producción aeroespacial avanzados			
Code	O07M197V01102			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	1	1c
Teaching language	Castelán Galego			
Department	Deseño na enxeñaría Enxeñaría dos materiais, mecánica aplicada e construción			
Coordinator	Álvarez González, David Pérez García, José Antonio			
Lecturers	Álvarez González, David Pérez García, José Antonio			
E-mail	japerez@uvigo.es davidag@uvigo.es			
Web	http://webs.uvigo.es/muea			
General description	Asignatura de materiais avanzados para a industria aeroespacial e producción.			

Resultados de Formación e Aprendizaxe

Code	
B3	Coñecemento adecuado dos materiais metálicos e materiais compostos utilizados na fabricación de vehículos aeroespaciais
B4	Coñecementos e habilidades que permitan comprender e levar a cabo os procesos de fabricación de vehículos aeroespaciais
B8	Coñecemento adecuado dos materiais e procesos de fabricación empregados nos sistemas de propulsión

Resultados previstos na materia

Expected results from this subject	Training and Learning Results
ID 6 Coñecemento axeitado dos materiais metálicos e materiales compostos empregados na fabricación de vehículos aeroespaciales ID7 Coñecemento e capacidades que permiten comprender e realizar os procesos de fabricación dos vehículos aeroespaciais. ID15 Coñecemento axeitado dos materiais e procesos de fabricación empregados nos sistemas de propulsión	B3 B4 B8

Contidos

Topic

Bloque Materiais	1. Criterios de selección e comportamento en servizo dos materiais aeroespaciais. -Introdución á selección de materiais. -Parámetros de deseño. -Propiedades mecánicas , térmicas, eléctricas, resistencia ao medio. 2. Materiais metálicos avanzados para estruturas aeronáuticas. -Aliaxes de aluminio avanzadas. -Aceiros inoxidables avanzados. -Materiais compostos matriz polimérica. 3. Materiais metálicos avanzados para sistemas propulsivos aeronáuticos e espaciais. -Aliaxes de Titanio -Superaleaciones -Cerámicos -Materiais compostos de matriz cerámica 4. Análise de Fallos en Servizo -Resistencia a corrosión -Termofluencia -Fractografía -Fatiga
Bloque Produción	5. Procesos avanzados de fabricación e control - Mecanizados non convencionais - Aplicacións da robótica en procesos de fabricación - Inspección automatizada mediante Máquinas de Medición por Coordenadas (MMC/CMM) 6. Indicadores e economía da fabricación - Produtividade e eficiencia dos procesos - Indicadores clave de rendemento (KPIs) en fabricación - Custos de fabricación 7. Sistemas avanzados de organización - Lean Manufacturing - Six Sigma 8. Prevención de riscos e saúde laboral na industria aeronáutica

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	30	30	60
Resolución de problemas	12	20	32
Prácticas de laboratorio	10	20	30
Prácticas con apoio das TIC	16	30	46
Traballo tutelado	0	53	53
Exame de preguntas obxectivas	4	0	4

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Metodoloxía docente

	Description
Lección maxistral	Exposición por parte do profesor dos contidos fundamentais da materia.
Resolución de problemas	Presentación e resolución por parte do profesor de problemas relativos aos procesos de fabricación estudados de maneira teórica coa participación activa das/os estudantes.
Prácticas de laboratorio	Introdución ao traballo con equipos de fabricación no laboratorio.
Prácticas con apoio das TIC	Introdución ao emprego de software de simulación de procesos de fabricación por parte do profesor. Coas instrucións recibidas e traballo autónomo, as/os estudantes poderán resolver problemas específicos que permitan mellorar o seu coñecemento sobre os procesos estudados.
Traballo tutelado	Realización de traballo individual e en grupos sobre temáticas propostas e realización de presentacións orais.

Atención personalizada

Methodologies	Description
Lección maxistral	

Prácticas de laboratorio		
Prácticas con apoio das TIC		
Traballo tutelado		
Resolución de problemas		

Avaliación			
	Description	Qualification	Training and Learning Results
Resolución de problemas	Entrega de problemas propostos resoltos	10	B3 B4 B8
Prácticas de laboratorio	Entrega de informes	15	B3 B4 B8
Prácticas con apoio das TIC	Entrega de informes	15	B3 B4 B8
Traballo tutelado	Entrega de memorias e realización de presentacións	25	B3 B4 B8
Exame de preguntas obxectivas	Cuestionario	35	B3 B4 B8

Other comments on the Evaluation

O modelo de avaliación é avaliación continua. O/A estudante ten dereito a optar pola avaliación global, **EXCLUSIVAMENTE**, segundo o procedemento e o prazo que estableza o centro para cada convocatoria.

O exame global consistirá nun exame escrito en data oficial que cubra todos os aspectos avaliados en avaliación continua.

PRIMEIRA OPORTUNIDADE:

A materia avalíase en base a catro parámetros:

- Exames teórico-prácticos (nota máxima 3,5 puntos). Consistirán en dúas probas para cada unha das partes (materiais e produción). A primeira durante o desenvolvemento do curso e a segunda na data oficial de exame. Nestas probas avalíanse os coñecementos teóricos da materia, cuestións relacionadas cos problemas e prácticas mediante un exame tipo test, desenvolvemento e/ou resposta curta.
- Resolución de problemas (nota máxima 1 punto). Avaliarase a entrega da resolución aos problemas expostos durante o curso nos prazos establecidos.
- Prácticas de laboratorio (nota máxima 1,5 puntos). Deberase participar nas actividades propostas durante o curso e entregar os informes requiridos.
- Prácticas con apoio do TIC (nota máxima 1,5 puntos). Deberase participar nas actividades propostas durante o curso e entregar os informes requiridos.
- Traballo tutelado (nota máxima 2,5 puntos). Deberase realizar o traballo solicitado e entregar unha memoria completa.

Aprobarán a materia aqueles alumnos que consigan unha nota igual ou superior a 5 puntos. Non se fará media no caso de que nunha parte a nota sexa inferior a 3,5 puntos, sendo a nota final de actas a nota da parte que non alcance o valor mínimo.

Non é posible recuperar ningunha proba a posteriori, salvo causa xustificada.

SEGUNDA OPORTUNIDADE:

O método de Avaliación é o mesmo que o descrito para a PRIMEIRA OPORTUNIDADE.

Poderanse gardar traballos da primeira oportunidade con cualificación >5. En ningún caso gardarase a cualificación dos exames.

OUTRAS CONSIDERACIÓNS:

En caso de detección de plaxio en calquera das probas, a cualificación final será de SUSPENSO (0) e o feito será comunicado

á dirección do Centro para os efectos oportunos.

As probas desenvolveranse durante o cuadrimestre. O exame teórico-práctico inicial desenvolverase en data a definir e indicada ás/os estudantes con antelación suficiente.

O calendario de probas de avaliación aprobado oficialmente pola Xunta de Centro da EEAE atópase publicado na páxina web http://aero.uvigo.es/gl/docencia/exames

A evaluación fin de carreira seguirá os mesmos criterios ca evaluación de 2ª oportunidade.

Bibliografía. Fontes de información

Basic Bibliography

Mikell P. Groover, **Automation, production systems, and computer-integrated manufacturing**, Pearson, 2016

Lee Harper, Mike Clifford (EDITORS), **Design and Manufacture of Structural Composites**, Elsevier, 2022

Abdel Salam Hamdy Makhlouf y Mahmood Aliokhazraei (edited), **Handbook of materials failure analysis with case studies from the aerospace and automotive industries**, Elsevier, 2016

Complementary Bibliography

Michael F. Ashby, **Materiales para la ingeniería. Introducción a la microestructura, el procesamiento y el diseño, volumen 2**, Reverté, 2009

N.E. Prasad, **Aerospace materials and materials technologies**, Springer, 2017

Fariborz Tayyari, **Cost Analysis for Engineers and Scientists**, CRC Press, 2022

Recomendacións

Other comments

Compromiso ético: Espérase que o alumnado manteña un comportamento ético adecuado. No caso de detectarse un comportamento non ético (copia, plaxio, utilización non autorizada de dispositivos electrónicos, entre outros), considerarase que o estudante non reúne os requisitos necesarios para superar a materia.
Neste caso, a cualificación global no curso académico correspondente será de suspenso (0,0).

Uso de ferramentas de Intelixencia Artificial (IA): En coherencia coas competencias de innovación e desenvolvemento e co deseño de sistemas de control avanzado establecidas na memoria do título, nesta materia foméntase o uso de ferramentas de IA como recurso de apoio para o deseño xerativo, a optimización predictiva de procesos e a asistencia na elaboración de documentación técnica.
Porén, o uso destas tecnoloxías debe rexer polos principios de transparencia e responsabilidade académica:

- Declaración de uso: O alumnado deberá indicar explicitamente nos seus informes e proxectos que ferramentas de IA foron utilizadas e con que finalidade.
- Validación crítica: Os resultados xerados pola IA deben ser verificados e analizados criticamente polo estudante; a entrega de resultados directos sen validación técnica considerarase unha falta de rigor profesional.
- Compromiso ético: O uso da IA para suplantar a autoría do traballo intelectual ou para xerar contidos sen a debida declaración tratarase conforme ás mesmas directrices que o plaxio ou a copia. Segundo o Regulamento da Universidade de Vigo, calquera comportamento non ético detectado implicará unha cualificación de suspenso (0,0) na materia.

Consideración final
En caso de discrepancia entre o contido desta guía en diferentes linguas, prevalecerá a versión en castelán.

IDENTIFYING DATA				
Deseño, cálculo e certificación de aeronaves e vehículos espaciales				
Subject	Deseño, cálculo e certificación de aeronaves e vehículos espaciales			
Code	O07M197V01103			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	1	1c
Teaching language	Castelán			
Department	Enxeñaría mecánica, máquinas e motores térmicos e fluídos			
Coordinator	Rey González, Guillermo David			
Lecturers	Rey González, Guillermo David			
E-mail	guillermo.rey@uvigo.es			
Web	http://webs.uvigo.es/muea			
General description	A materia "Deseño, cálculo e certificación de aeronaves e vehículos espaciais" é unha disciplina de enxeñaría aplicada. Nela faise uso dos coñecementos apresos no grao para abordar, a fase inicial de deseño conceptual segundo requisitos de deseño, e as dúas fases de *validación do deseño, o cálculo e a *validación/certificación. No primeiro bloque da materia séguese este proceso para aeronaves e no segundo para vehículos espaciais.			

Resultados de Formación e Aprendizaxe	
Code	
B5	Coñecementos e habilidades para a análise e deseño estrutural de aeronaves e vehículos espaciais, incluíndo a aplicación de programas de cálculo e deseño avanzado de estruturas.
B6	Coñecemento adecuado dos distintos subsistemas de aeronaves e vehículos espaciais
C1	Capacidade para deseñar, executar e analizar as probas en terra e en voo de vehículos aeroespaciais, así como para realizar un proceso completo de certificación dos mesmos.
D3	Comprensión e dominio da mecánica de voo atmosférico (rendementos, estabilidade, control estático e dinámico), mecánica orbital e dinámica de actitudes.

Resultados previstos na materia		
Expected results from this subject		Training and Learning Results
IDE5. Comprensión e dominio da mecánica de voo atmosférico (actuacións, estabilidade, control estático e dinámico), da mecánica orbital e da dinámica de actitude.		D3
IDE8. Coñecementos e capacidades para a análise e deseño estrutural das aeronaves e vehículos espaciais, incluíndo a aplicación de programas de cálculo e deseño avanzado de estruturas	B5	
IDE9. Capacidade para deseñar, executar e analizar os ensaios en terra e en voo dos vehículos aeroespaciais, e para levar a cabo un proceso completo de certificación dos mesmos.		C1
IDE10. Coñecemento adecuado dos distintos subsistemas das aeronaves e vehículos espaciais.	B6	

Contidos	
Topic	
Aeronaves: requisitos e deseño preliminar	-Configuración xeral de aeronaves de transporte. -Características másicas, aerodinámicas e propulsivas. -Cálculo de actuacións -Extensión a outras aeronaves
Aeronaves: deseño conceptual e arquitectura	-Estrutura -Sistemas e equipos de abordo.
Aeronaves: certificación e ensaios	-Certificación da aeronavegabilidad. -Ensaios de certificación -Investigación de accidentes.
Vehículos espaciais: requisitos e deseño preliminar	-Misións espaciais -Contornas de operación e desenvolvemento -Orbitas -Xeometría de misións espaciais

Vehículos espaciais: deseño conceptual e arquitectura	-Subsistemas de vehículos espaciais -Potencia -Estrutura -Control térmico -AOCS -Comunicacións
Vehículos espaciais: verificación e ensaios	-Garantía de produto -Integración e ensaios

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	39	39	78
Resolución de problemas	8	18	26
Prácticas con apoio das TIC	22	22	44
Aprendizaxe baseado en proxectos	1	74	75
Exame de preguntas de desenvolvemento	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Exposición dun tema ou resolución de problemas por parte do profesorado segundo un guión previamente establecido.
Resolución de problemas	Resolución de problemas e/ou exercicios que tratan aspectos puntuais dos contidos da materia, desenvolvidos polo profesorado e/ou o alumnado na aula
Prácticas con apoio das TIC	Uso dos medios dispoñibles TIC na escola para abordar o predeseño tanto de aeronaves como de vehículos espaciais
Aprendizaxe baseado en proxectos	Metodoloxía activa na que o alumnado adquire coñecementos e competencias mediante o desenvolvemento de proxectos significativos, promovendo a autonomía, a colaboración, o pensamento crítico e a aplicación práctica das aprendizaxes.

Atención personalizada	
Methodologies	**Description**
Lección maxistral	A atención personalizada mediante titorías individuais e grupais ofrece orientación académica continua, resolve dúbidas, favorece o seguimento da aprendizaxe, potencia a motivación e adapta o apoio ás necesidades do alumnado.
Resolución de problemas	A atención personalizada mediante titorías individuais e grupais ofrece orientación académica continua, resolve dúbidas, favorece o seguimento da aprendizaxe, potencia a motivación e adapta o apoio ás necesidades do alumnado.
Prácticas con apoio das TIC	A atención personalizada mediante titorías individuais e grupais ofrece orientación académica continua, resolve dúbidas, favorece o seguimento da aprendizaxe, potencia a motivación e adapta o apoio ás necesidades do alumnado.
Aprendizaxe baseado en proxectos	A atención personalizada mediante titorías individuais e grupais ofrece orientación académica continua, resolve dúbidas, favorece o seguimento da aprendizaxe, potencia a motivación e adapta o apoio ás necesidades do alumnado.

Avaliación			
	Description	Qualification	Training and Learning Results
Aprendizaxe baseado en proxectos	Metodoloxía activa na que o alumnado adquire coñecementos e competencias mediante o desenvolvemento de varios proxectos significativos, promovendo a autonomía, a colaboración, o pensamento crítico e a aplicación práctica das aprendizaxes. Ningún dos proxectos superará o 40% da nota final da materia	60	B5 C1 D3 B6
Exame de preguntas de desenvolvemento	Exame baseado na resolución de problemas e/ou preguntas conceptuais sobre os contidos da materia. Será en data de exame oficial. Nota mínima de 4.0.	40	B5 C1 D3 B6

Other comments on the Evaluation

Convocatoria de primeira oportunidade.

(1) Estudantes que seguen o curso por Avaliación Continua.

Para poder superar a materia na primeira oportunidade, mediante Avaliación Continua, será necesario:

- Unha nota, no exame final de avaliación continua de, como mínimo, un 4.0.
- Asistir a, como mínimo, o 90% das sesións de prácticas.
- Entregar a totalidade de memorias prácticas e traballos dela materia obtendo, como mínimo, unha nota de 3 en cada un deles.

No caso de non cumprir devanditas condicións a nota final será a resultante do mínimo da nota media ponderada de EC e de 4.9.

(2) Estudante que desexen ser avaliados mediante avaliación global.

A avaliación do curso na primeira oportunidade realizarase, por defecto, mediante Avaliación Continua. O estudantado ten dereito a optar pola avaliación global segundo o procedemento e o prazo que estableza a universidade e o centro para cada convocatoria.

A nota obtida neste exame representará o 100% da nota final. O estudante deberá obter unha nota mínima de 5.0 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e/o laboratorio, e comprenderá a totalidade da materia impartida, así como os contidos abordados en todas as sesións prácticas e traballos.

Convocatoria de segunda oportunidade e fin de carreira.

O estudantado que non superase a materia na primeira oportunidade poderá realizarán un exame que supoñerá o 100% da nota. O estudante deberá obter unha nota mínima de 5.0 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e/o laboratorio,e comprenderá a totalidade da materia impartida, así como os contidos abordados en todas as sesións prácticas e traballos.

Uso de IA

Permítese o uso de ferramentas de Intelixencia artificial (IA) como apoio para a realización das actividades da materia, salvo que se indique expresamente o contrario. Cando se utilicen estas ferramentas, o estudantado deberá declarar sempre a súa utilización de forma explícita nos traballos entregados. En todo caso, será responsable do contido entregado e deberá poder xustificar a súa autoría e o proceso seguido para a súa elaboración. O uso destas tecnoloxías deberá acollerse en todo momento á normativa vixente da universidade de matrícula neste ámbito.

O profesorado poderá solicitar aclaracións, evidencias adicionais ou defensas individuais dos traballos realizados co fin de verificar a adquisición das competencias da materia. Nestas sesións individuais, o estudante deberá demostrar que comprendeu plenamente o contido do seu traballo e o proceso seguido para a súa elaboración.

Normas de aplicación nas probas presenciais.

Durante as probas, non se permite o uso de reloxos, dispositivos que emitan ou reciban radiofrecuencias, teléfonos móbiles nin ningún outro dispositivo electrónico na aula, salvo aqueles expresamente autorizados pola dirección do centro por motivos médicos, segundo a resolución correspondente á solicitude de adaptación de estudantes con necesidades educativas especiais. Durante as probas, todo o alumnado deberá manter os seus pavillóns auditivos despexados para comprobar que non utilizan dispositivos non autorizados.

No caso de que se detecte a algún alumno ou alumna con material non autorizado durante calquera proba, copiando, intentando copiar ou simplemente tendo o material na aula, será motivo de medida disciplinaria. Tras a identificación, pediráselle que abandone a aula e a súa cualificación final será de 0 puntos.

Copia ou plaxio

En caso de detección de copia e/o plaxio en calquera elemento de cualificación, a cualificación na devandita entrega será 0 e o feito será comunicado á dirección do Centro para os efectos oportunos.

Bibliografía. Fontes de información

Basic Bibliography

Daniel P. Raymer, **Aircraft Design: A Conceptual Approach**, 9781624107153, 7, American Institute of Aeronautics, 2024

Snorri Gudmundsson, **General Aviation Aircraft Design**, 9780128184653, 2, Butterworth-Heinemann, 2022

Peter Fortescue, Graham Swinerd, John Stark, **Spacecraft Systems Engineering**, 9780470750124, 4, Wiley John + Sons, 2011

James R. Wertz, Wiley Larson, **Space Mission Analysis and Design**, 9780792359012, 3, Springer, 1999

Complementary Bibliography

Grant E. Carichner, Leland M. Nicolai, **Fundamentals of Aircraft and Airship Design. Volume 2**, 9781600868986, 1, American Institute of Aeronautics, 2013

John Anderson, **Aircraft Performance & Design**, 9780070019713, 1, McGraw-Hill Education, 1988

Recomendacións

Subjects that continue the syllabus

Cálculo avanzado de estructuras aeroespaciales/O07M197V01202

Deseño, cálculo e certificación de sistemas de propulsión aeroespaciales/O07M197V01203

Sistemas mecánicos, térmicos e eléctricos espaciales/O07M197V01303

IDENTIFYING DATA				
Advanced fluid mechanics				
Subject	Advanced fluid mechanics			
Code	O07M197V01104			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Martín Ortega, Elena Beatriz			
Lecturers	Domínguez Estévez, Pablo Martín Ortega, Elena Beatriz			
E-mail	emortega@uvigo.es			
Web	http://webs.uvigo.es/muea			
General description	Subject that includes advanced knowledge of fluid flows, from a theoretical and numerical perspective, including also reactive flows. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B1	Adequate knowledge of advanced fluid mechanics, with special emphasis on computational fluid mechanics and turbulence phenomena
B7	Adequate knowledge of advanced fluid mechanics, with special emphasis on experimental and numerical techniques used in fluid mechanics.
D4	Understanding and mastering the phenomena associated with combustion and heat and mass transfer.

Expected results from this subject	Training and Learning Results	
Know how to analyse flows (both incompresible and compressible flows, including flows with combustion) by means of Computational Dynamics Techniques In this subject, we will focus on: - using numerical and/or analytical methods to solve a fluid flow problem - Working by projects	B1 B7	D4
ID2. Adequate knowledge of advanced fluid mechanics, with special emphasis on computational fluid mechanics and turbulence phenomena.	B1	
ID 12 Adequate knowledge of advanced fluid mechanics, with special emphasis on experimental and numerical techniques used in fluid mechanics.	B7	
ID 13 Understanding and mastering the phenomena associated with combustion and heat and mass transfer.		D4

Contents	
Topic	
1. REVISION OF NAVIER-STOKES EQUATIONS	1.1. Principles of conservation of mass, linear momentum and energy. 1.2. Euler Equations. 1.3. Initial and boundary conditions 1.4. Dimensionless formulation, dimensionless parameters and physical similarity. Application to the Rayleigh problem.
2. BOUNDARY LAYERS	2.1 Introduction. Equations of the boundary layer. Introduction to perturbations. Thicknesses and general considerations. Laminar boundary layers 2.2. Integral equation of Karman. 2.3. Blausius Solution. Effects of suction/blown. 2.4. Solutions of Falkner-Skan. 2.5. Thermal boundary layer 2.6. Effects of compressibility. Boundary layers at very high speed

3. NAVIER-STOKES EQUATIONS FOR REACTIVE MIXTURES	3.1 Multicomponents mixtures: molar Fraction. Mass fraction. Equation of state. Speed of diffusion. 3.2 Conservation Equation for the chemical species. Molecular transport in multicomponents mixtures. Navier-Stokes Equations for reactive flows 3.3 Introduction to the chemistry of combustion. Global and elementary reactions. Dependency of the constants of reaction with the temperature. Hypothesis of steady state. Hypothesis partial equilibrium 3.4 Thermokinetics. Stoichiometry and dosage. Adiabatic flame temperature. Chemical balance. 3.5 Length and time scales. Relevant dimensionless numbers 3.6 Applications. Numerical simulation of combustion processes
4. TURBULENCE	4.1 Review of properties of turbulence. Free turbulence. Turbulent dynamic boundary layer. Turbulent thermal boundary layer 4.2 RANS and LES models.
5. ADVANCED NUMERICAL TECHNIQUES IN FLUID DYNAMICS	5.1 Finite Volume Methods (FVM) 5.2 Implementation of the FVM 5.3 Pressure based methods. Density based methods 5.4 Examples of discretisation 5.5 Residuals and their meaning. 5.6 Numerical Simulation of different compressible and incompresible flows
6. INTRODUCTION TO EXPERIMENTAL MEASUREMENTS IN FLUIDS	6.1. Characterisation of Turbulent Flow 6.2. Measurement of Temperature and Heat flow 6.3 Measure of Pressure 6.4 Measure of forces 6.5 Hot-wire anemometer. 6.6 Laser anemometer 6.7 Other measurement and visualisation techniques for fluids

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Practices through ICT	16.5	0	16.5
Mentored work	0	62	62
Problem solving	0	40	40
Problem and/or exercise solving	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
Lecturing	Explanation by the professor of the contents on the subject of study, the theoretical bases and/or the guidelines for work, exercise or project to be developed by the student.
Practices through ICT	Activities of application of knowledge to specific situations, and of acquisition of basic skills related with the subject of study in the informatic partical classes of simulation of flows
Mentored work	Activity in which one or several longer problems are formulated, where the student has to apply the knowledge acquired in the masterclasses and in the numerical simulation classes.
Problem solving	Activity in which problems and/or short exercises related with the subject are formulated. The student has to find the correct solutions by means of the application of procedures, use of available information. The student has to interpretate the obtained results. It is a complementary activity to the lectures

Personalized assistance	
Methodologies	**Description**
Lecturing	Student questions formulated during the lectures will be addressed, as well as questions asked during the computer practices. Likewise, students will be attended personaly during the subject tutorships.

Practices through ICT	Student questions formulated during the lectures will be addressed, as well as questions asked during the computer practices. Likewise, students will be attended personaly during the subject tutorships.
Mentored work	Students will be attended personaly during the subject tutorships.
Problem solving	Students will be attended personaly during the subject tutorships.

Assessment

	Description	Qualification	Training and Learning Results	
Mentored work	Evaluation task in which the student solves numerically a specific flow problem asigned by the professor. The student will analyse it and will resolve the problem using the numerical techniques. The work will be uploaded to the Moovi platform befor the oficial date of the exam	30	B1 B7	D4
Problem solving	Completion of two assessments to evaluate the competences acquired. These assessments may include closed-ended questions with different answer options (true/false, multiple choice, matching items, etc.), the application of knowledge to the resolution of specific fluid mechanics problems and/or questions, or the completion of a numerical simulation assignment. The first of these assessments, which may be held in person or submitted as an assignment, will account for 30% of the final course grade. The second of these assessments will take place on the official date of the final course examination and will account for 40% of the final course grade. A minimum grade of 3.75 over 10 in this examination is required in order to pass the course.	70	B1 B7	D4

Other comments on the Evaluation

First assessment opportunity:

In order to pass the course in the first assessment opportunity, students must obtain a mark higher than 3.75 out of 10 in the final examination of the subject, as well as a mark higher than 5 out of 10 in the combined assessment of the continuous assessment tests/assignments and the examination held on the official date. If the mark of 3.75 in the final examination is exceeded, the final mark for the course shall be obtained in accordance with the indicated percentages. If a mark equal to or lower than 3.75 out of 10 is obtained in the final examination, the final mark for the course shall be the mark obtained in the final examination.

Use of AI

The use of AI shall be limited to supporting students in the completion of very specific and limited tasks within continuous assessment assignments. Any assignment that is wholly or partially the direct result of the use of an artificial intelligence program shall not be accepted. The use of AI in on-site tests shall be strictly prohibited. Where there are well-founded indications of improper use of AI, the teaching staff may reject assignments, request additional tests, or refer the case to the corresponding disciplinary procedure.

Global assessment:

Students have the right to opt for global assessment in accordance with the procedure and deadline established by the centre for each examination period.

An examination shall be held on the official date, covering all the contents of the subject, including the contents and methods used in the case studies. A mark of 5 out of 10 in this examination shall be required to pass the subject.

The officially approved assessment calendar of the School Board of the EEAE is published on the website:

http://aero.uvigo.es/gl/docencia/exames

Second assessment opportunity:

If the final continuous assessment mark obtained in the first assessment opportunity is lower than 5 out of 10, students must sit the second-opportunity examination covering all the contents of the subject, which shall account for 100% of the final mark.

If the student has obtained a mark equal to or higher than 5 out of 10 in the combined assignments/tests of the continuous

assessment in the first assessment opportunity, this mark shall be retained for the second assessment opportunity, and the student shall only have to sit the official examination, which shall have a weight of 40% in the final mark for the subject. In order to pass the subject, the mark obtained in the final examination must be higher than 3.75 out of 10, and the average of the continuous assessment assignments/tests and the examination must be higher than 5.0. If the student does not exceed 3.75 out of 10 in the final examination, the final mark for the subject shall be the mark obtained in the examination.

Final-degree assessment:

For the final-degree assessment, an examination shall be held on the official date, covering all the contents of the subject. A mark of 5 out of 10 in this examination shall be required to pass the subject.

In all assessments:

Use of electronic devices

During tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic device in the classroom is not permitted, except for those expressly authorised by the centre management for medical reasons, in accordance with the corresponding resolution regarding the request for adaptation by students with special educational needs. During tests, all students must keep their ears uncovered so that it can be verified that they are not using unauthorised devices. If any student is detected with unauthorised material during any test, whether copying, attempting to copy, or simply having such material in the classroom, this shall be grounds for disciplinary action. After identification, the student shall be asked to leave the classroom, and their final mark shall be 0 points.

Sources of information

Basic Bibliography

White, F.M, **Viscous fluid flow,**, 3rd ed., McGraw-Hill,, 2006

Panton, R. L., **Incompressible Flow**, 4th Edition, Wiley, 2013

Anderson, **Modern Compressible Flow**, 3nd Ed., Mc Graw Hill, 1992

H K Versteeg and W Malalasekera, **An Introduction to Computational Fluid Dynamics THE FINITE VOLUME METHOD,**, 2nd Ed., Prentice Hall, 2007

Complementary Bibliography

SCHLICHTING, H,, **Boundary Layer Theory**, Mc Graw Hill, 1987

FERZIGER, J., MILOVAN, P., **Computational Methods for fluid Dynamics**, Springer, 1999

F. Moukalled L. Mangani M. Darwish, **The Finite Volume Method in Computational Fluid Dynamics An Advanced Introduction with OpenFOAM® and Matlab®**, Springer, 2016

WILCOX, **Turbulence Modeling**, DCW Industries, 2004

Stavros Tavoularis, **Measurement in Fluid Mechanics**, Cambridge University Press,, 2005

GLASSMAN, **Combustion**, 4th edition, Elsevier, 2008

www.openfoam.org,

www,openfoam.com,

Recommendations

Other comments

Devote the time indicated for personal work, as well as use the personal tutorships with the professor to solve the possible doubts that arise during the personal work of the student.

It is recommended to study continuosly from the very beginning of the subject as well as to mantain an active attitude in the classes.

IDENTIFYING DATA				
Flight Dynamic				
Subject	Flight Dynamic			
Code	O07M197V01201			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Orgeira Crespo, Pedro			
Lecturers	Orgeira Crespo, Pedro			
E-mail	porgeira@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	The study of the equations of the dynamic motion of aircraft and space vehicles is addressed. As a previous step, the static stability and control of the airplane is studied, in straight flight and maneuver. Subsequently, the dynamic equations of motion are analyzed: linearizing them, obtaining the derivatives of longitudinal and lateral-directional stability, the modes of the airplane, and the stability and control in open and closed loop. Finally, an introduction is made to the attitude dynamics of space vehicles, their equations and applied to orientation control maneuvers.			

Training and Learning Results	
Code	
D3	Understanding and mastery of atmospheric flight mechanics (performance, stability, static and dynamic control), orbital mechanics and attitude dynamics.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Understanding and command of atmospheric flight mechanics (actions, stability, static and dynamic control), orbital mechanics and attitude dynamics.	D3

Contents	
Topic	
1. Static stability and control of the aircraft	- Brief review of static stability and static control of the aircraft. - Response of the aircraft to inputs on the aerodynamic controls. - Longitudinal static stability and control in manoeuvre
2. Stability and dynamic control of the aircraft	- Linearization of the general equations of the plane's motion. - Derivatives of longitudinal and lateral-directional stability. - Longitudinal and lateral-directional dynamic modes. - Dynamic stability and controllability in closed loop. - Flight qualities (FQ) and flight control systems (FCS).
3. Orbital mechanics and attitude dynamics of space vehicles	- Kinematics of rotational attitude - Attitude dynamics of rigid solid - Rotational maneuvers and attitude control

Planning			
	Class hours	Hours outside the classroom	Total hours
Case studies	12	62	74
Lecturing	29	0	29
Previous studies	0	30	30
Problem solving	4.5	0	4.5
Autonomous problem solving	0	10	10
Objective questions exam	1.5	0	1.5
Objective questions exam	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

Case studies	Realization of practical case studies on the contents of the subject, which will be explained and started in the classroom to be finished and delivered by the students outside the classroom. The case studies will require the use of software.
Lecturing	Presentation of a topic or resolution of problems by the teaching staff according to a previously established script.
Previous studies	Students study autonomously, with the support of the teaching staff if required according to the procedures established by the university for tutorials
Problem solving	Resolution of problems and/or exercises that deal with specific aspects of the contents of the subject, developed by the teaching staff and/or the students in the classroom
Autonomous problem solving	Resolution of problems and/or exercises that deal with specific aspects of the contents of the subject, developed by the students outside the classroom

Personalized assistance

Methodologies	Description
Case studies	Realization of practical case studies on the contents of the subject, which will be explained and started in the classroom to be finished and delivered by the students outside the classroom. The students will have the necessary tutorials with the teaching staff to monitor the development of the case studies.
Previous studies	Support tutorials for students to study independently, according to the procedures established by the university.

Assessment

	Description	Qualification	Training and Learning Results
Case studies	Four case studies to be carried out during the semester distributed over time, and software will be used for their resolution.	30	D3
Objective questions exam	Exam based on solving problems and/or conceptual questions about the contents of the subject. It will be on the official exam date.	40	D3
Objective questions exam	Exam based on solving problems and/or conceptual questions about the contents of the subject. It will be on the official exam date.	30	D3

Other comments on the Evaluation

By default, the evaluation is assumed to be continuous. The student has the right to opt for the global evaluation according to the procedures and deadlines established by the center for each call.-

Continuous assesment:-

At the first exam call:

A partial, redeemable exam covering part of the course content will be held during the term. To pass this exam and be exempt from that portion of the course, a grade of 5 out of 10 is required. However, if the grade exceeds 4 out of 10, this portion can still be passed if the other sections of the course bring the overall final grade to at least 5 out of 10. The weight of this test in the final grade is 30%..

A final exam will be held on the official date set by the center. The written test will consist of two parts: a first part for students who passed the partial exam, with a weight of 40% in the final grade; and a second part, for students who did not pass the partial exam (with a weight of 30%)

A group (or indiividual) project will be conducted, contributing 30% to the final grade. Each member of the group may receive a different individual grade (in case of groupal project)

-

The minimum grade required in any test is 4 out of 10 in order to balance the exam and practicals. To pass the course, weighted grade of 5 out of 10 (including written exams and assignments) must be acheived. The written tests may consist of multiple-choice questions and/or short-answer questions and/or essay-type questions.

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In the second exam call:

-

Students who have not passed the subject at the first call will take an exam that covers all aspects of the subject, on the official date indicated by the center.

-

To pass the course, a minimum grade of 5 out of 10 must be achieved. The exam may consist of test-type questions and/or short-answer questions and/or essay-type questions.

-

Exam-only assesment/End-of-program call:

-

A final exam will be held on the official date set by the center, which will cover all aspects of the subject.

-

To pass the course, a minimum grade of 5 out of 10 must be achieved. The exam may consist of test-type questions and/or short-answer questions and/or essay-type questions.

If plagiarism is detected in any graded item, a grade of 0 will be assigned for that item, and the incident will be reported to the Center's management for appropriate action.

During the tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic devices is not permitted in the classroom, except for those expressly authorized by the school administration for medical reasons, according to the resolution corresponding to the request for students with special educational needs. During the tests, all students must keep their ears uncovered to ensure they are not using unauthorized devices.

If any student is found with unauthorized material during any test, whether copying, attempting to copy, or simply possessing the material in the classroom, it will be grounds for disciplinary action. After identification, the student will be asked to leave the classroom, and their final grade will be 0 points.

Sources of information

Basic Bibliography

Gómez Tierno M.A., Pérez Cortés M., Puentes Márquez C, **Mecánica del vuelo**, 2, Ibergarceta Publicaciones, 2012

Complementary Bibliography

Bong Wie, **Space Vehicle Dynamics and Control**, 2, American Institute of Aeronautics and Astronautics, 2008

Bernard Etkin, Lloyd Duff Reid, **Dynamics of flight. Stability and control**, 3, John Wiley & Sons, 1996

Recommendations

Subjects that are recommended to be taken simultaneously

Avionics/O07M197V01205

Subjects that it is recommended to have taken before

Advanced aerodynamics and aeroelasticity/O07M197V01101

IDENTIFYING DATA				
Advanced calculation of aerospace structures				
Subject	Advanced calculation of aerospace structures			
Code	O07M197V01202			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	García Luis, Uxía			
Lecturers	García Luis, Uxía			
E-mail	uxia.garcia.luis@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	In the subject "Advanced calculation of aerospace structures" we start from the more general knowledge acquired in the degree about the functioning of structures, to specify structures for aerospace use, which have requirements that differentiate them from other structures. After completing the course, the student should be able to design and analyze the combinations of structures and materials in the most common boundary conditions in the industry. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B3	Adequate knowledge of metallic and composite materials used in aerospace vehicle manufacturing
B5	Knowledge and skills for the structural analysis and design of aircraft and spacecraft, including the application of advanced structural design and calculation programs
D1	Ability to design, build, inspect, certify and maintain all types of aircraft and spacecraft

Expected results from this subject	Training and Learning Results
GO1. Aptitude to project, build, inspect, certify and keep all type of aircraft and space vehicles.	D1
GO6. Suitable knowledge of the metallic materials and compound materials used in the manufacture of aerospace vehicles.	B3
GO8. Knowledges and capacities for the analysis and structural design of the aircraft and space vehicles, including the application of programs of calculation and design advanced of structures.	B5

Contents	
Topic	
Types of aerospace structures	-Typologies of structures -Structures of aeronautical use -Structures of space use
Types of structural analysis	-Static analysis -Dynamic Analysis -Analysis stability
Materials for aerospace use	-Linear elastic materials -Non-linear elastic materials -Plastic materials -Visco-elastic materials
Multidisciplinary analysis and optimisation	-Multidisciplinary analysis joined up -Optimisation of structures

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	29	57

Practices through ICT	15.5	0	15.5
Case studies	1	73	74
Objective questions exam	2.5	0	2.5
Case studies	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
Lecturing	Exhibition by part of the professor of the contents on the matter object of study, theoretical bases and guidelines of a work or exercise that the/the student has to develop.
Practices through ICT	Activities of application of the knowledges in a determinate context and of acquisition of basic skills and procedures in relation with the matter, through the TIC, fundamentally with tools of simulation used in the industry.
Case studies	Realisation of cases of practical study on the contents of the subject, the which will be explained and initiated in the classroom to be finished and delivered by part of the students out of the classroom. The cases of study will require of the use of specific software

Personalized assistance	
Methodologies	**Description**
Case studies	Realisation of cases of practical study on the contents of the subject, the which will be explained and initiated in the classroom to be finished and delivered by part of the students out of the classroom. The students will have of the personal lessons necessary with the professor for the follow-up of the development of the cases of study

Assessment				
	Description	Qualification	Training and Learning	Results
Objective questions exam	Examination based in the resolution of problems and/or conceptual questions on the contents of the subject. It will be in date of official examination.	40	B3 B5	D1
Case studies	Throughout the course, 4 small case studies will be presented that will constitute the different parts of a larger project, each being 15% of the total grade.	60	B3 B5	D1

Other comments on the Evaluation

First Call Evaluation

(1) Students following the course through Continuous Assessment

To pass the course through this pathway, the following conditions must be met simultaneously:

- Attendance. Minimum of 90% to practical sessions.
- Minimum grade per test. A 4.0 in each evaluable test.

In the case of not meeting these conditions, the final grade will be the result between the weighted average grade of the Continuous Assessment and a maximum of 4.9.
(2) Students wishing to be evaluated through Exam-only Assessment
The evaluation of the course in the first call will be carried out, by default, through Continuous Assessment. Students have the right to choose the Exam-only Assessment according to the procedure and deadline established by the center for each call, through an exam that will account for 100% of the final grade. This exam will integrate the entirety of the taught course material, including the contents of all practical sessions and assignments (potentially including tests in the computer room or laboratory). To pass, a minimum grade of 4.0 will be required in each of the theoretical and practical topics, in addition to a 5.0 in the weighted average of all of them.
Second Call and End-of-program Call Evaluation
Students who have not passed the course in the first call may take an exam that will account for 100% of the final grade. This exam will integrate the entirety of the taught course material, including the contents of all practical sessions and assignments (potentially including tests in the computer room or laboratory). To pass, a minimum grade of 4.0 will be required in each of the theoretical and practical topics, in addition to a 5.0 in the weighted average of all of them. If the student has already passed the practical part in Continuous Assessment, they will not need to be examined on it again. In case of wanting to be examined again on the practical part, they must explicitly request it through exam-only assessment for this second call. **Regarding the use of Artificial Intelligence (AI)**

The use of AI tools is permitted as a support in the development of the evaluable tests of the course (except in development-question exams). However, students must be fully aware of their learning process and responsible for the submitted content. The use of AI for the complete generation of content or identity substitution will be considered academic fraud. In the event of well-founded evidence of improper use of AI, the teaching staff may reject the work, request additional evidence, or refer the case to the corresponding disciplinary procedure.

Regarding the use of electronic devices

During the tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic devices is not permitted in the classroom, except for those expressly authorized by the school administration for medical reasons, according to the resolution corresponding to the request for students with special educational needs. During the tests, all students must keep their ears uncovered to ensure they are not using unauthorized devices.

If any student is found with unauthorized material during any test, whether copying, attempting to copy, or simply possessing the material in the classroom, it will be grounds for disciplinary action. After identification, the student will be asked to leave the classroom, and their final grade will be 0 points.

Sources of information

Basic Bibliography

Complementary Bibliography

T. H. G. Megson, **Aircraft Structures for Engineering Students**, 6, Butterworth-Heinemann, 2016

D. J. Peery, **Aircraft Structures**, Dover Publications, 2011

Bruhn, **Analysis and Design of Flight Vehicle Structures**, Jacobs Pub, 1973

M. Niu, **Airframe Structural Design: Practical Design Information and Data on Aircraft Structures**, 1988

J. Wijker, **Spacecraft Structures**, Springer, 2008

V.P Singh, **Mechanical Vibrations**, Dhanpat Rai, 2014

Recommendations

Subjects that are recommended to be taken simultaneously

Flight Dynamic/O07M197V01201

Subjects that it is recommended to have taken before

Advanced aerospace materials and production/O07M197V01102

Other comments

Given the absence of the subject of Vibrations in one of the two intensifications of the degree we recommend to the students that do not have it passed the study of the concepts that are given in the said subject. In particular the book Mechanical Vibrations included in the bibliography recommended constitutes a good introduction.

IDENTIFYING DATA				
Design, calculation and certification of aerospace propulsion systems				
Subject	Design, calculation and certification of aerospace propulsion systems			
Code	O07M197V01203			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Ulloa Sande, Carlos			
Lecturers	Ulloa Sande, Carlos			
E-mail	carlos.ulloa@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	In this subject the main aim is to develop the capacity to design and calculate performances of jet engines and their components. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B9	Adequate knowledge of aerojets, gas turbines, rocket engines and turbomachines.
B10	Adequate knowledge of the different subsystems of aerospace vehicle propulsion plants.
C2	Ability to design, build and select the most suitable power plant for an aerospace vehicle, including self-derived power plants
C3	Ability to design, execute and analyze propulsion system tests, and to carry out the complete propulsion system certification process.
D6	Ability to undertake the mechanical design of different components of a propulsion system, as well as the propulsion system as a whole.

Expected results from this subject	Training and Learning Results		
GO11. Aptitude to project, build and select the plant of power more adapted for an aerospace vehicle, including the plants of power autoderivated.		C2	
GO16. Know adapted of jet engines, turbines of gas, engines rocket and turbomáchinery.	B9		
GO17. Capacity to tackle the mechanical design of distinct components of a propulsive system, as well as of the system propulsive in his group.			D6
GO18. Capacity to design, execute and analyse the essays of propulsive systems , and to carry out the complete process of certification of the same..		C3	
GO19. Suitable knowledge of the distinct subsystems of the propulsive plants of aerospace vehicles.	B10		

Contents	
Topic	
Performances of jet engines	-Global performances: biaxial, turbofans, -Performances of components: takings, compressors, cameras of combustion, turbines, nozzles -Non- steady state performances
Essays and material	-Banks of essays -Calculation of the no measured parameters -Models pre-essay -Material used in jet engines
Multidisciplinary appearances of propulsive systems	-Interaction with other subsystems -objective Functions -Application to the design of systems of control -Other appearances to consider

Technicians of simulation	-Types of models of jet engines -Decomposition of systems -Levels of fidelity
Introduction to space propulsion systems	-Introduction to autonomous propulsion systems -Chemical rocket engines -Solid propellant rocket engines -Liquid propellant rocket engines

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	29	62	91
Problem solving	6	12	18
Mentored work	5	16	21
Laboratory practical	6	12	18
Essay questions exam	2	0	2

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Exhibition by part of the professor of the contents on the matter object of study, theoretical bases and guidelines of a work or exercise that the/the student has to develop.
Problem solving	Activity in which they formulate problems and /or exercises related with the matter. The student has to develop the suitable solutions by means of the exertion 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 used to employ as I complement of the theoretical lesson
Mentored work	Activity in which they formulate a problem of design related with the matter. The student has to develop by his account the suitable solutions by means of the exertion of routines, the application of formulas or algorithms. At the end of the course has to present the work in class
Laboratory practical	Labs with different propulsion systems Simulation labs of propulsion systems

Personalized assistance

Methodologies	Description
Problem solving	Realisation of practical problems on the contents of the subject, the which will be explained and initiated in the classroom to be finished and delivered by part of the students out of the classroom. The students will have of the personal lessons necessary with the professor for the follow-up of the development of the cases of study

Assessment

	Description	Qualification	Training and Learning Results		
Mentored work	Document consisting of the design of a propulsion system with the concepts learned in the subject and with presentation in class.	20	B9 B10	C2 C3	D6
Laboratory practical	Laboratory report.	10	B9 B10	C2 C3	D6
Essay questions exam	Two exams based on the resolution of problems and/or conceptual questions about the contents of the subject. The first one will be taken in class and the second one will be on the official exam date. Each exam will be weighted 35% of the final grade.	70	B9 B10	C2 C3	D6

Other comments on the Evaluation

First opportunity:

(1) Students following the course by Continuous Assessment:

In order to pass the subject at the first opportunity, by Continuous Assessment, it will be necessary:

- An average grade in the continuous Assessment exams of 5.0.

- Attend at least 80% of the practical sessions.

- To deliver the totality of practical reports and works of the subject obtaining, at least, a grade of 3 in each one of them.

In case of not fulfilling these conditions, the final grade will be the result of the minimum of the average grade of EC and 4.9.

The continuous assessment tests will be carried out during class time, whenever possible. The final exam of continuous assessment will be held on the date approved by the center for the first opportunity.

(2) Students who wish to be evaluated by global evaluation:

The evaluation of the course at the first opportunity will be carried out, by default, by Continuous Assessment. The students have the right to opt for the global evaluation according to the procedure and the term established by the center for each call, which may not exceed one month.

The grade obtained in this exam will represent 100% of the final grade.

The student must obtain a minimum grade of 5.0 in this exam. This exam may have a part to be taken in a computer room and / or laboratory, and will cover the entire subject taught, as well as the contents covered in all practical sessions and assignments. The global evaluation exam will be held on the date approved by the center for the first opportunity.

Second opportunity and End of Career: Students who did not pass the subject in the first opportunity and waive the continuous evaluation, may take an exam that will account for 100% of the final grade. The student must obtain a minimum grade of 5.0 in this exam. This exam may have a part to be taken in a computer room and / or laboratory, and will cover the entire subject taught, as well as the contents covered in all practical sessions and assignments. The student who was evaluated by continuous assessment at the first opportunity and did not pass it, will be re-evaluated for the final exam of Continuous Assessment and must meet the requirements to pass the subject by continuous assessment.

The second opportunity and final exams will be held on the dates approved by the center for each call.

Other considerations:

In case of detection of plagiarism in any qualification item, the qualification in that item will be 0 and the fact will be communicated to the Center's management for the appropriate purposes.

The evaluation test schedule officially approved by the Board of the EEAE Center is published on the website https://muea.webs.uvigo.es/es/docencia/examenes/

Sources of information

Basic Bibliography

Complementary Bibliography

J.L Kerrebrock, **Aircraft Engines and Gas Turbines**, 2, MIT Press, 1992

G. Sutton, **Rocket Propulsion Elements**, 9, Wiley, 2016

Recommendations

Subjects that it is recommended to have taken before

Design, calculation and certification of aircraft and space vehicles/O07M197V01103

IDENTIFYING DATA				
Advanced air navigation systems				
Subject	Advanced air navigation systems			
Code	O07M197V01204			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	#EnglishFriendly #ItalianoAmichevole Spanish Galician			
Department				
Coordinator	Veiga López, Fernando			
Lecturers	Veiga López, Fernando			
E-mail	fernando.veiga@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	The course provides a fundamental vision of air navigation and circulation. Its objective is to describe how the information obtained by different sensors is used to allow safe and efficient air navigation. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B11	Adequate knowledge of avionics and on-board software, simulation and control techniques used in air navigation.
B12	Adequate knowledge of wave propagation and the problems of links with ground stations.
B14	Adequate knowledge of the different regulations applicable to air navigation and air traffic, as well as the ability to certify air navigation systems.
C4	Ability to define and design air traffic navigation and management systems, to design airspace, maneuvers and aeronautical easements.
C5	Ability to design RADAR systems and air navigation aids.
D9	Competence to plan, design, manage and certify the procedures, infrastructures and systems that support aerospace activities, including air navigation systems.

Expected results from this subject	Training and Learning Results		
Ability to define and design air traffic navigation and management systems, to design airspace, maneuvers and aeronautical easements		C4	
Adequate knowledge of avionics and on-board software, simulation and control techniques used in air navigation	B11		
Adequate knowledge of wave propagation and the problems of links with ground stations	B12		
Ability to design RADAR systems and air navigation aids		C5	
Adequate knowledge of the different regulations applicable to air navigation and air traffic, as well as the ability to certify air navigation systems	B14		
Competence to plan, design, manage and certify the procedures, infrastructures and systems that support aerospace activities, including air navigation systems			D9

Contents	
Topic	
1. Introduction to Navigation. Aeronautical cartography. Reference system WGS84 linked to Earth.	- Introduction, motivation, course and evaluation rules, etc. - Review of reference systems applied to aeronautics. - Review of aeronautical cartography.
2. Positioning by situation surfaces based on radio beacons. VOR, ILS, DME systems.	- Review of navigation systems based on ground radio aids.
3. Satellite positioning. GPS, GLONASS, GALILEO systems. ADSB system.	- Review of navigation systems based on satellite radio aids.
4. Inertial measurement systems.	- Operational flight (Random Navigation, PBN). - Guidance, navigation and control: positioning and inertial navigation.
5. Algoritmos de estimación de la posición. Filtro de Kalman.	- Estimation algorithms. Filter of n-measures and alpha-beta (linear). - Kalman filter.

6. Airspace organization and design. Flow and separation management.	- Introduction to common optimization methods. - Air traffic flow management (ATFM - route optimization) - Laboratory: methods for optimizing air traffic. - Collision and evasion maneuvers. - Laboratory: Collision and evasion maneuvers.
7. CNS/ATM systems. Regulations, definition of operational requirements, operation and maintenance.	- Review of CNS/ATM concepts. - ATM system performance. - Introduction to SESAR. - Laboratory: Flight plan. - Laboratory: Flight simulator. - Air navigation procedures (instrumental approach and takeoff).

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Laboratory practical	16.5	0	16.5
Mentored work	0	102	102
Objective questions exam	1.25	0	1.25
Objective questions exam	1.25	0	1.25

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Exposure of the contents of the subject through audiovisual media.
Laboratory practical	Troubleshooting using software tools.
Mentored work	The student will carry out a project based on technical specifications defined by the professor.

Personalized assistance

Methodologies	Description
Lecturing	Classroom attention. Tutorials with previous appointment. Attention by email. Mail: higiniog@uvigo.gal
Laboratory practical	Classroom attention. Tutorials with previous appointment. Attention by email. Mail: higiniog@uvigo.gal
Mentored work	Tutorials with previous appointment. Attention by email. Mail: higiniog@uvigo.gal

Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practical	Laboratory report (total - 4 reports, 5% each)	20	B11 B12 B14	C4 C5	D9
Mentored work	Group project	25	B11 B12 B14	C4 C5	D9
Objective questions exam	Partial exam I	27.5	B11 B12 B14	C4 C5	D9
Objective questions exam	Partial exam II	27.5	B11 B12 B14	C4 C5	D9

Other comments on the Evaluation

TThe student will have the right to go for global or continuous evaluation according to the procedure and deadlines established by the center for each call.

Continuous assessment:

When choosing this option, the students must deliver the indicated items, in a timely manner, by the teaching staff of the subject to pass it at the first opportunity, with the percentage of each deliverable being the one indicated in the previous table. The average grade must be higher or equal than 5 to pass the subject.

The laboratory practices will be evaluated by the teaching staff via a written/oral report.

Regarding the evaluation of the mentored work, a detailed report will be delivered per group of the entire process and the results obtained by the students and each group will give an oral presentation of the work carried out.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Midterm exams will be carried out in person during school hours in written format, with short answer questions and small problems related to the concepts of the part of the subject evaluated.

In each of the items presented, at least a grade of 4/10 will be required to pass the subject through continuous evaluation at the first opportunity. Furthermore, the average grade of the two midterm exams must be higher than 4.5/10. The student may repeat the partial exams on the ordinary call whenever the grade is higher than 3/10. If the minimum requirements are not met, the grade recorded in the transcript will be either the first partial exam grade or the average of both.

If this first opportunity is not passed, the consecutive ones (second opportunity or end of degree) will consist of a global exam of the two indicated parts that will correspond to 100% of the subject and will be carried out on the official exam dates. It will be necessary to achieve a minimum grade of 5/10 to pass the subject. Grades will not be kept between different calls.

Global evaluation:

If global evaluation is selected, the official exam dates in all calls (first opportunity, second opportunity or end of degree) will be used for the student to take a global exam of the subject. The qualification for this exam will correspond to a 100% of the grade. It will be necessary to achieve a minimum grade of 5 to complete and pass the subject. Grades will not be kept between different calls.

Calendar of evaluation tests officially approved by the *Xunta de Centro* of the EEAE is published on the website:

http://aero.uvigo.es/es/docencia/examenes/

Sources of information

Basic Bibliography

Francisco Javier Sáez Nieto, **Navegación aérea: Posicionamiento, Guiado y Gestión del Tráfico Aéreo**, Ibergarceta Publicaciones S.L., 2012

Complementary Bibliography

Luis Pérez Sanz et al., **Introducción al sistema de navegación aérea**, Ibergarceta Publicaciones S.L., 2013

Recommendations

Subjects that are recommended to be taken simultaneously

Avionics/O07M197V01205

IDENTIFYING DATA				
Avionics				
Subject	Avionics			
Code	O07M197V01205			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Veiga López, Fernando			
Lecturers	Veiga López, Fernando			
E-mail	fernando.veiga@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	This subject aims to teach students the main electronic systems present in an aircraft. Mainly, the communication, control, fuel and navigation systems among others. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B12	Adequate knowledge of wave propagation and the problems of links with ground stations.
B13	Adequate knowledge of aeronautical information technologies and communications.
C5	Ability to design RADAR systems and air navigation aids.

Expected results from this subject	Training and Learning Results
Adequate knowledge of wave propagation and the problems of links with ground stations	B12
Ability to design RADAR systems and air navigation aids	C5
Adequate knowledge of aeronautical information technologies and communications	B13

Contents	
Topic	
1. Introduction and specific problems in on-board equipment.	- Introduction, motivation, clarification of evaluation standards.
2. Noise and interference. EM compatibility. Optical and optoelectronic solutions.	- Basic notions of electromagnetic waves and problems derived from wave propagation. - Noise and interference. - Communication systems and MS regulations. - Signals and post-processing laboratory: Introduction to signal processing, signal acquisition and post-processing.
3. Power supply systems. Requirements and structures.	- Electrical system of an aircraft.
4. Sensors, actuators and other input and output devices.	- Aircraft-pilot interface. - Onboard navigation systems. - Inertial sensors - attitude derivation. - Other aircraft systems (fuel, alert, etc.). - UAV avionics.
5. Electronic signal collection and delivery and preprocessing.	- Air data acquisition systems. - External data acquisition laboratory (Pitot + barometric altimeter).
6. Baseband signal transmission. ARINC and MIL buses.	- Description of the most used buses in avionics. - Integration of avionics subsystems.

7. Information processing and on-board software. Simulation and Control Techniques.	- Necessary concepts of aerodynamics, stability, control and response of the aircraft. - Control laboratory: closed control loop with Arduino (PID). - PCUs and stability increase systems. - Fly by wire. - Autopilot. - Flight management systems (FMS).

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Laboratory practical	16.5	0	16.5
Mentored work	0	102	102
Objective questions exam	1.25	0	1.25
Objective questions exam	1.25	0	1.25
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Exposure of the contents of the course through audiovisual media.
Laboratory practical	Troubleshooting through laboratory assemblies.
Mentored work	The student will carry out a project based on technical specifications defined by the professor.

Personalized assistance	
Methodologies	**Description**
Lecturing	Classroom attention. Tutorials with previous appointment. Attention by email. Mail: fernando.veiga@uvigo.gal
Laboratory practical	Classroom attention. Tutorials with previous appointment. Attention by email. Mail: fernando.veiga@uvigo.gal
Mentored work	Tutorials with previous appointment. Attention by email. Mail: fernando.veiga@uvigo.gal

Assessment				
	Description	Qualification	Training and Learning Results	
Laboratory practical	Laboratory report (total - 3 reports, 5% each)	15	B12 B13	C5
Mentored work	Team project (aircraft control system)	30	B12 B13	C5
Objective questions exam	Partial exam I	25	B12 B13	C5
Objective questions exam	Partial exam II	30	B12 B13	C5

Other comments on the Evaluation

The student will have the right to go for global or continuous evaluation according to the procedure and deadlines established by the center for each call.

Continuous assessment:

When choosing this option, the students must deliver the indicated items, in a timely manner, by the teaching staff of the subject to pass it at the first opportunity, with the percentage of each deliverable being the one indicated in the previous table. The average grade must be higher or equal than 5 to pass the subject.

The laboratory practices will be evaluated by the teaching staff via a reduced written report.

Regarding the evaluation of the mentored work, a detailed report will be delivered per group of the entire process and the results obtained by the students and each group will give an oral presentation of the work carried out.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Midterm exams will be carried out in person during school hours in written format, with short answer questions and small problems related to the concepts of the part of the subject evaluated.

In each of the items presented, at least a grade of 4/10 will be required to pass the subject through continuous evaluation at the first opportunity. Furthermore, the average grade of the two midterm exams must be higher than 4.5/10. If the minimum requirements are not met, the grade recorded in the transcript will be either the first partial exam grade or the average of both.

If this first opportunity is not passed, the consecutive ones (second opportunity or end of degree) will consist of a global exam of the two indicated parts that will correspond to 100% of the subject and will be carried out on the official exam dates. It will be necessary to achieve a minimum grade of 5/10 to pass the subject. Grades will not be kept between different calls.

Global evaluation:

If global evaluation is selected, the official exam dates in all calls (first opportunity, second opportunity or end of degree) will be used for the student to take a global exam of the subject. The qualification for this exam will correspond to a 100% of the grade. It will be necessary to achieve a minimum grade of 5 to complete and pass the subject. Grades will not be kept between different calls.

Calendar of evaluation tests officially approved by the *Xunta de Centro* of the EEAE is published on the website: http://aero.uvigo.es/es/docencia/examenes/

Sources of information
Basic Bibliography
Jesús Martínez Rueda, **Aviónica básica en aeronaves**, Ediciones Paraninfo, 2021
Ian Moir, Allan Seabridge, **Aircraft Systems: Mechanical, electrical, and avionics subsystems integration**, John Wiley & Sons, Ltd, 2008
R.P.G. Collinson, **Introduction to Avionics Systems**, 4, Elsevier, 2023
Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously
Advanced air navigation systems/O07M197V01204

IDENTIFYING DATA				
Management of Spatial Processes				
Subject	Management of Spatial Processes			
Code	O07M197V01301			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Orgeira Crespo, Pedro			
Lecturers	Orgeira Crespo, Pedro Rey González, Guillermo David			
E-mail	porgeira@uvigo.es			
Web	http://muea.webs.uvigo.es/			
General description	The subject covers the planning and management of space projects, including risk analysis. It delves into the manufacturing and integration of spacecraft, addressing the materials and processes involved. Additionally, it examines the testing and validation required to ensure the proper functioning of spacecraft. The course also includes the ground segment and operations control, as well as quality standards and product assurance to guarantee reliability in the space environment.			

Training and Learning Results	
Code	
B3	Adequate knowledge of metallic and composite materials used in aerospace vehicle manufacturing
B4	Knowledge and skills to understand and perform aerospace vehicle manufacturing processes.
C1	Ability to design, execute and analyze ground and flight tests of aerospace vehicles, and to carry out a complete aerospace vehicle certification process.
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject	Training and Learning Results		
ID6. Adequate knowledge of metallic materials and composite materials used in the manufacturing of aerospace vehicles.	B3		
ID7. Knowledge and skills that allow understanding and carrying out the manufacturing processes of aerospace vehicles.	B4		
ID9. Ability to design, perform, and analyze ground and flight tests of aerospace vehicles, and to carry out a complete certification process of the same.		C1	
ID35. Understand and apply the knowledge and tools necessary to develop space engineering projects. D11			D11
ID36. Conceive space products that meet the needs of the stakeholders involved, defining functions, concepts, and their architecture.		C8	

Contents
Topic
Topic 1. Introduction to PMP certification and PMBOK 7.
Topic 2. Standard for project management.
Topic 3. Project management domains.
Topic 4. Planning and implementation of space projects.
Topic 5. Bidding for space projects.
Topic 6. Configuration and information management of space projects.
Topic 7. Cost management and scheduling of space projects.
Topic 8. Risk management in space projects.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Practices through ICT	16.5	0	16.5
Essay	102	0	102
Objective questions exam	1.5	0	1.5
Objective questions exam	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
Lecturing	(*)Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e/o directrices dun traballo, exercicio que o/a estudante ten que desenvolver
Practices through ICT	(*)Actividade na que se formulan problema e/o exercicios relacionados coa materia. O alumno debe desenvolver as solucións idóneas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Adóitase empregar como complemento da lección maxistral.

Personalized assistance	
Tests	**Description**
Essay	

Assessment					
	Description	Qualification	Training and Learning Results		
Essay	Development of one or more assignments related to the subject content.	20	B3 B4	C1 C8	D11
Objective questions exam	Exam consisting of problems and/or essay questions and/or multiple-choice questions.	40	B3 B4	C1 C8	D11
Objective questions exam	Exam consisting of problems and/or essay questions and/or multiple-choice questions.	40	B3 B4	C1 C8	D11

Other comments on the Evaluation

By default, the evaluation is assumed to be continuous. The student has the right to opt for the global evaluation according to the procedures and deadlines established by the center for each call.-

Continuous assesment:-

At the first exam call:

A partial, redeemable exam covering part of the course content will be held during the term. To pass this exam and be exempt from that portion of the course, a grade of 5 out of 10 is required. However, if the grade exceeds 4 out of 10, this portion can still be passed if the other sections of the course bring the overall final grade to at least 5 out of 10. The weight of this test in the final grade is 30%..

A final exam will be held on the official date set by the center. The written test will consist of two parts: a first part for students who passed the partial exam, with a weight of 40% in the final grade; and a second part, for students who did not pass the partial exam (with a weight of 30%)

A group (or indiividual) project will be conducted, contributing 30% to the final grade. Each member of the group may receive a different individual grade (in case of groupal project)

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The minimum grade required in any test is 4 out of 10 in order to balance the exam and practicals. To pass the course, weighted grade of 5 out of 10 (including written exams and assignments) must be acheived. The written tests may consist of multiple-choice questions and/or short-answer questions and/or essay-type questions.

-

In the second exam call:

-

Students who have not passed the subject at the first call will take an exam that covers all aspects of the subject, on the official date indicated by the center.

-

To pass the course, a minimum grade of 5 out of 10 must be achieved. The exam may consist of test-type questions and/or short-answer questions and/or essay-type questions.

-

Exam-only assesment/End-of-program call:

-

A final exam will be held on the official date set by the center, which will cover all aspects of the subject.

-

To pass the course, a minimum grade of 5 out of 10 must be achieved. The exam may consist of test-type questions and/or short-answer questions and/or essay-type questions.

If plagiarism is detected in any graded item, a grade of 0 will be assigned for that item, and the incident will be reported to the Center's management for appropriate action.

During the tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic devices is not permitted in the classroom, except for those expressly authorized by the school administration for medical reasons, according to the resolution corresponding to the request for students with special educational needs. During the tests, all students must keep their ears uncovered to ensure they are not using unauthorized devices.

If any student is found with unauthorized material during any test, whether copying, attempting to copy, or simply possessing the material in the classroom, it will be grounds for disciplinary action. After identification, the student will be asked to leave the classroom, and their final grade will be 0 points.

Sources of information

Basic Bibliography

Project Management Institute, **A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - The Standard for Project Management**, 7, Project Management Institute, 2021

European Cooperation for Space Standardization, **ECSS handbooks**, European Cooperation for Space Standardization,

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Advanced calculation of aerospace structures/O07M197V01202
Design, calculation and certification of aerospace propulsion systems/O07M197V01203

Subjects that it is recommended to have taken before

Design, calculation and certification of aircraft and space vehicles/O07M197V01103

IDENTIFYING DATA				
Space environment and mission analysis				
Subject	Space environment and mission analysis			
Code	O07M197V01302			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Ulloa Sande, Carlos			
Lecturers	García Luis, Uxía Ulloa Sande, Carlos			
E-mail	carlos.ulloa@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	The subject "space environment and mission analysis" addresses the study of the space environmental conditions to which a space vehicle is subjected, and the analysis of all the elements of systems engineering to be considered to define and characterize a space mission. Vacuum, microgravity, magnetic fields, radiation, plasma and meteorites are considered. The mission analysis focuses on the concepts of operation, the definition of operations, the functional architecture, the definition of requirements, the orbital calculation, the calculation of budgets by subsystems, the definition of the launch and reentry system, and the control of guidance of the space vehicle.			

Training and Learning Results	
Code	
B6	Adequate knowledge of the different subsystems of aircraft and spacecraft
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D3	Understanding and mastery of atmospheric flight mechanics (performance, stability, static and dynamic control), orbital mechanics and attitude dynamics.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject	Training and Learning Results
Understanding and mastery of atmospheric flight mechanics (performance, stability, static and dynamic control), orbital mechanics and attitude dynamics.	D3
Adequate knowledge of the different subsystems of aircraft and spacecraft	B6
Understand and apply the knowledge, methods and tools necessary to develop space engineering projects	D11
To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.	C8

Contents	
Topic	
1. Space missions in the solar system	1.1. Solar system. Overview of the space environment. 1.2. Mission analysis. 1.2.1. Systems engineering study. - Concept of operations - Functional architecture - Requirements - Interfaces. - Budgets 1.2.2. Orbital Dynamics. Mission types - Earth Missions. Nearby space environment Earth (magnetic, electric, gravitational field). Meteorites and space debris - Interplanetary missions. Plasma and space 1.2.3. Space propulsion systems. Dv Calculation
2. Launch into orbit and re-entry	2.1. Launch systems 2.2. Reentry vehicles

3. Guidance and control of space vehicles	3.1. Attitude dynamics 3.2. Attitude control and guidance. Effect of disturbances

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Previous studies	0	30	30
Mentored work	5	66	71
Case studies	12	6	18
Objective questions exam	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation of a topic or resolution of problems by teachers according to a content guide previously established.
Previous studies	Study of the students autonomously, with the support of the teaching staff if required according to the procedures established by the university for tutoring sessions
Mentored work	The project of the subject consists of carrying out a conceptual design project for a space mission. The work is done individually, dedicating work sessions in class for tutoring and monitoring outside the classroom. The work includes: mission analysis, space environment, launch segment, and control and guidance subsystem. For each part of the project, case studies will be previously carried out in the classroom, which guide the students in the preparation of the project.
Case studies	Carrying out practical case studies on the contents of the subject, which will be explained and started in the classroom to be completed by the students outside the classroom. The case studies will require the use of software and will be applied in the supervised project.

Personalized assistance	
Methodologies	**Description**
Previous studies	Study of the students autonomously, with the support of the teaching staff if required according to the procedures established by the university for tutoring sessions
Mentored work	The project of the subject consists of carrying out a conceptual design project for a space mission. The work is done individually, dedicating work sessions in class for tutoring and monitoring outside the classroom. The work includes: mission analysis, space environment, launch segment, and control and guidance subsystem. For each part of the project, case studies will be previously carried out in the classroom, which guide the students in the preparation of the project.

Assessment					
	Description	Qualification	Training and Learning Results		
Mentored work	The work of the subject consists of carrying out a conceptual design project for a space mission.	40	B6	C8	D3 D11
Case studies	Test in computer lab to solve a practical case.	20	B6	C8	D3 D11
Objective questions exam	Exam based on problem solving and/or conceptual questions about the contents of the subject.	40	B6	C8	D3 D11

Other comments on the Evaluation

First call:

(1) Students following the course by Continuous Assessment:

In order to pass the course at the first opportunity, by Continuous Assessment, it will be necessary:

-A grade in the final exam of continuous assessment of, at least, a 3.5.

-Attend at least 80% of the practical sessions.

-Submit all the practical reports and assignments of the subject, obtaining, at least, a grade of 3 in each one of them.

In the case of not meeting these conditions, the final grade will be the result of the minimum of the average grade of EC and 4.9.

The continuous assessment tests will be carried out during school hours, whenever possible. The final continuous assessment exam will be held on the date approved by the center for the first call.

(2) Students who wish to be evaluated by exam-only assessment:

The evaluation of the course at the first call will be made, by default, through Continuous Assessment. The student body has the right to opt for the exam-only assessment according to the procedure and the period established by the center for each call, which may not exceed one month.

The grade obtained in this exam will represent 100% of the final grade. The student must obtain a minimum grade of 5.0 in this exam. This exam may have a part to be taken in a computer room and / or laboratory, and will cover the entire subject taught, as well as the contents covered in all practical sessions and assignments.

The exam-only assessment exam will be held on the date approved by the center for the first call.

Second call and end-of-program call:

Students who have not passed the subject at the first call and have waived the continuous assessment, may take an exam only assessment exam that will account for 100% of the final grade. The student must obtain a minimum grade of 5.0 in this exam. This exam may have a part to be taken in a computer room and / or laboratory, and will cover the entire subject taught, as well as the contents covered in all practical sessions and assignments. The student who has been evaluated by continuous assessment at the first call and has not waived it, will be re-evaluated for the final exam of Continuous Assessment and must meet the requirements to pass the subject by continuous assessment.

The second call and end-of-program assessment exam will be held on the dates approved by the center for each call.

Other considerations:

In case of detection of plagiarism in any qualification element, the qualification in said item will be 0 and the fact will be communicated to the direction of the Center for the appropriate effects.

The evaluation test schedule officially approved by the Board of the EEAE Center is published on the websitepublished on the website https://muea.webs.uvigo.es/gl/docencia/exames/.

Sources of information

Basic Bibliography

Larson W.J. and Wertz J.R., **Space mission analysis and design**, 3, Microcosm Press, 1999

Complementary Bibliography

Vincent L. Pisacane, **Fundamentals of Space Systems**, 2, Oxford University Press, 2005
Howard D. Curtis, **Orbital Mechanics for Engineering Students**, 4, Elsevier Ltd., 2020
Don Edberg and Willie Costa, **Design of Rockets and Space Launch Vehicles**, 2, AIAA, 2022

Recommendations

Subjects that are recommended to be taken simultaneously

Space sciences/O07M197V01307
Space propulsion/O07M197V01309
Orbit and Attitude Control Systems/O07M197V01308
Space Observation Systems/O07M197V01306
Management of Spatial Processes/O07M197V01301
Space mechanical, thermal and electrical systems/O07M197V01303
Space telecommunication systems/O07M197V01305

Subjects that it is recommended to have taken before

Flight Dynamic/O07M197V01201
Design, calculation and certification of aircraft and space vehicles/O07M197V01103

IDENTIFYING DATA				
Space mechanical, thermal and electrical systems				
Subject	Space mechanical, thermal and electrical systems			
Code	O07M197V01303			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	García Luis, Uxía			
Lecturers	García Luis, Uxía			
E-mail	uxia.garcia.luis@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	In the subject "Mechanical System, Thermal and Electrical Space tackle said subsystems with the object that the student learn the foundations of the same, so much to theoretical level to be able to do initial designs, as that familiarise with the distinct technologies employed in the same. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
B5	Knowledge and skills for the structural analysis and design of aircraft and spacecraft, including the application of advanced structural design and calculation programs
B6	Adequate knowledge of the different subsystems of aircraft and spacecraft
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D4	Understanding and mastering the phenomena associated with combustion and heat and mass transfer.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject	Training and Learning Results	
GO8. Knowledges and capacities for the analysis and structural design of the aircraft and space vehicles, including the application of programs of calculation and design advanced of structures.	B5	
GO10. Suitable knowledge of the distinct subsystems of the aircraft and space vehicles.	B6	
GO13. Understanding and command of the phenomena associated to combustion and to the transfer of heat and mass.		D4
GO35. Comprise and apply the knowledges and necessary tools to develop projects of space engineering.		D11
GO36. Conceive space products that correspond to the needs of the agents involved, defining functions, concepts and his architecture.	C8	

Contents	
Topic	
Electrical power subsystem	-Primary sources -Storage, distribution, regulation and control.
Structures and mechanisms	-Structural loads -Modelling and design.
Thermal control subsytem	-Technologies -Thermal loads -Modelling and design.
Protection to electromagnetic radiation and plasma.	-Electromagnetic radiation -Plasma.

Planning	Class hours	Hours outside the classroom	Total hours

Lecturing	28	29	57
Practices through ICT	15.5	0	15.5
Case studies	1	73	74
Objective questions exam	2.5	0	2.5
Case studies	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
Lecturing	Exhibition by part of the professor of the contents on the matter object of study, theoretical bases and guidelines of a work or exercise that the/the student has to develop.
Practices through ICT	Activities of application of the knowledges in a determinate context and of acquisition of basic skills and procedures in relation with the matter, through the TIC, fundamentally with tools of simulation used in the industry.
Case studies	Realisation of cases of practical study on the contents of the subject, the which will be explained and initiated in the classroom to be finished and delivered by part of the students out of the classroom. The cases of study will require of the use of specific software

Personalized assistance

Methodologies	Description
Case studies	Realisation of cases of practical study on the contents of the subject, the which will be explained and initiated in the classroom to be finished and delivered by part of the students out of the classroom. The students will have of the personal lessons necessary with the professor for the follow-up of the development of the cases of study

Assessment

	Description	Qualification	Training and Learning Results		
Objective questions exam	Examination based in the resolution of problems and/or conceptual questions on the contents of the subject. It will be in date of official examination.	40	B5 B6	C8	D4 D11
Case studies	Along the subject will present 4 practical works, each one being 15% of the total note. 1 - Power system 2 - Spacecraft structure 3 - Thermal control subsystem 4 - Integration	60	B5 B6	C8	D4 D11

Other comments on the Evaluation

First Call Evaluation

(1) Students following the course through Continuous Assessment

To pass the course through this pathway, the following conditions must be met simultaneously:

- Attendance. Minimum of 90% to practical sessions.
- Minimum grade per test. A 4.0 in each evaluable test.

In the case of not meeting these conditions, the final grade will be the result between the weighted average grade of the Continuous Assessment and a maximum of 4.9.

(2) Students wishing to be evaluated through Exam-only Assessment

The evaluation of the course in the first call will be carried out, by default, through Continuous Assessment. Students have the right to choose the Exam-only Assessment according to the procedure and deadline established by the center for each call, through an exam that will account for 100% of the final grade.

This exam will integrate the entirety of the taught course material, including the contents of all practical sessions and assignments (potentially including tests in the computer room or laboratory). To pass, a minimum grade of 4.0 will be required in each of the theoretical and practical topics, in addition to a 5.0 in the weighted average of all of them.

Second Call and End-of-program Call Evaluation

Students who have not passed the course in the first call may take an exam that will account for 100% of the final grade.

This exam will integrate the entirety of the taught course material, including the contents of all practical sessions and assignments (potentially including tests in the computer room or laboratory). To pass, a minimum grade of 4.0 will be required in each of the theoretical and practical topics, in addition to a 5.0 in the weighted average of all of them.

If the student has already passed the practical part in Continuous Assessment, they will not need to be examined on it again. In case of wanting to be examined again on the practical part, they must explicitly request it through exam-only assessment for this second call. **Regarding the use of Artificial Intelligence (AI)**

The use of AI tools is permitted as a support in the development of the evaluable tests of the course (except in development-question exams). However, students must be fully aware of their learning process and responsible for the submitted content. The use of AI for the complete generation of content or identity substitution will be considered academic fraud. In the event of well-founded evidence of improper use of AI, the teaching staff may reject the work, request additional evidence, or refer the case to the corresponding disciplinary procedure.

Regarding the use of electronic devices

During the tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic devices is not permitted in the classroom, except for those expressly authorized by the school administration for medical reasons, according to the resolution corresponding to the request for students with special educational needs. During the tests, all students must keep their ears uncovered to ensure they are not using unauthorized devices.

If any student is found with unauthorized material during any test, whether copying, attempting to copy, or simply possessing the material in the classroom, it will be grounds for disciplinary action. After identification, the student will be asked to leave the classroom, and their final grade will be 0 points.

Sources of information

Basic Bibliography

Complementary Bibliography

J. Wijker, **Spacecraft Structures**, Springer, 2008

W. Larson, J, Wertz, **Space Mission Analysis and Design**, 3, Microcosm Press, 1999

D. Gilmore, **Spacecraft Thermal Control**, 2, Aerospace Press,

R, Patel, **Spacecraft Power Systems**, CRC Press, 2023

Recommendations

Subjects that are recommended to be taken simultaneously

Space environment and mission analysis/O07M197V01302

Subjects that it is recommended to have taken before

Advanced calculation of aerospace structures/O07M197V01202

Design, calculation and certification of aircraft and space vehicles/O07M197V01103

IDENTIFYING DATA				
Software crítico para sistemas espaciales				
Subject	Software crítico para sistemas espaciales			
Code	O07M197V01304			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2	1c
Teaching language	Castelán Galego			
Department	Informática			
Coordinator	Formella , Arno			
Lecturers	Formella , Arno González Castro, Miguel Ramón Pérez Cota, Manuel			
E-mail	formella@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	Introdúcese e analiza sistemas de software crítico especialmente no ámbito espacial, como estes sistemas están tratados nos estándares correspondentes, e como afrontar a súa complexidade con equipos interdisciplinares.			

Resultados de Formación e Aprendizaxe	
Code	
B13	Coñecemento adecuado das tecnoloxías da información e das comunicacións aeronáuticas
C8	Deseñar produtos espaciais que se correspondan coas necesidades dos axentes implicados, definindo funcións, conceptos e a súa arquitectura.
D11	Comprender e aplicar os coñecementos, métodos e ferramentas necesarios para desenvolver proxectos de enxeñería espacial.

Resultados previstos na materia			
Expected results from this subject	Training and Learning Results		
Saber analizar e comprender a complexidade de software crítico no sector espacial incluíndo o segmento terreo e sistemas aeronáuticos de apoio. Faise especial fincapie en estándares dispoñibles, propostas xa implantadas, e a necesidade de traballo en equipos interdisciplinares.	B13	C8	D11
Deseñar produtos espaciais que se correspondan coas necesidades dos axentes implicados, definindo funcións, conceptos e a súa arquitectura.		C8	
Coñecemento adecuado das tecnoloxías da información e das comunicacións aeronáuticas	B13		
Comprender e aplicar os coñecementos, métodos e ferramentas necesarios para desenvolver proxectos de enxeñería espacial.			D11

Contidos	
Topic	
Introdución	Software crítico Exemplos de erros Complexidade e ferramentas Dispoñibilidade
Estándares	ECSS ISO/IEC Control industrial outros
Deseño software	Hardware Requisitos Redundancia Interfaces Documentación Calidade

Verificación e validación	Comprobación Test Integración Mantemento
Computador de abordo	Exemplo Software embebido Protocolo TC/TM (PUS)
Simulación	Uso Virtualización Xemelgo dixital

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	29	0	29
Prácticas con apoio das TIC	16.5	40.5	57
Traballo tutelado	0	40	40
Presentación	0.5	15.5	16
Exame de preguntas obxectivas	1	3	4
Exame de preguntas de desenvolvemento	1	3	4
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	Exposición por parte dos docentes dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio ou proxecto a desenvolver polo estudante.
Prácticas con apoio das TIC	Actividades de aplicación de coñecementos a situacións concretas, e de adquisición de habilidades básicas e procedementos relacionadas coa materia obxecto de estudo, que se realizan en aulas de informática.
Traballo tutelado	Actividade na que se formula un ou varios problemas de extensión temporal máis longa, onde o ou a estudante debe aplicar os coñecementos adquiridos tanto nas clases maxistrais como nas clases de prácticas informáticas.

Atención personalizada	
Methodologies	**Description**
Lección maxistral	Atenderase de forma personalizada aos e as estudantes na sesión de preguntas que se formularán durante as sesións maxistrais, así como nas prácticas informáticas. Así mesmo atenderase aos e as estudantes de forma personalizada nas sesións de titorías dos docentes.
Prácticas con apoio das TIC	Atenderase de forma personalizada aos e as estudantes na sesión de preguntas que se formularán durante as sesións maxistrais, así como nas prácticas informáticas. Así mesmo atenderase aos e as estudantes de forma personalizada nas sesións de titorías dos docentes.
Traballo tutelado	Atenderase aos e as estudantes de forma personalizada nas sesións de titorías dos docentes.
Tests	**Description**
Presentación	Atenderase de forma personalizada aos e as estudantes na sesión de presentacións que se formularán durante as exposicións. Así mesmo atenderase aos e as estudantes de forma personalizada nas sesións de *titorías dos docentes.

Avaliación			
	Description	Qualification	Training and Learning Results
Lección maxistral	Resolución de problemas e/ou exercicios durante a clase maxistral ou conferencia. Proba na que o estudantado debe solucionar problemas ou exercicios propostos nun tempo e condicións establecidos polo docente. Desta forma, o estudantado debe aplicar os coñecementos que adquiriu.	5	B13 C8 D11
Traballo tutelado	Informe de prácticas en formato escrito. Elaboración dun informe por parte do estudantado no que se reflicten as características do traballo levado a cabo. O estudantado debe describir as tarefas e procedementos desenvolvidos, mostrar os resultados obtidos ou as observacións realizas, así como a análise e tratamento dos datos.	40	B13 C8 D11

Presentación	Informe de prácticas en formato oral. Elaboración dunha presentación por parte do estudantado no que se reflicten as características do traballo levado a cabo. O estudantado debe presentar as tarefas e procedementos desenvolvidos, mostrar os resultados obtidos ou as observacións realizas, así como a análise e tratamento dos datos.	20	B13 C8 D11
Exame de preguntas obxectivas	Exame de preguntas de curtas. Proba de avaliación que inclúe preguntas abertas sobre o tema. O estudantado debe desenvolver, relacionar, organizar e presentar os coñecementos que ten sobre a materia nunha resposta curta.	15	B13 C8 D11
Exame de preguntas de desenvolvemento	Exame de preguntas de desenvolvemento. Proba de avaliación que inclúe preguntas abertas sobre o tema. O estudantado debe desenvolver, relacionar, organizar e presentar os coñecementos que ten sobre a materia nunha resposta máis extensa.	20	B13 C8 D11

Other comments on the Evaluation

Avaliación da primeira oportunidade:

Para superar a materia na 1a oportunidade será necesario obter unha nota superior a 5 puntos sobre 10 na avaliación conxunta das probas de avaliación continua, dos traballos entregados durante o desenvolvemento das clases e do exame realizado no data oficial. A cualificación final da avaliación continua obterase segundo as porcentaxes indicadas.

O estudante ten dereito a optar á avaliación global segundo o procedemento e prazo que estableza o centro para cada convocatoria.

Avaliación global:

Na data oficial realizarase un exame no que se inclúen todos os contidos da materia, incluídos os contidos e métodos empregados nos casos prácticos. A nota do devandito exame para superar a materia será de 5 puntos sobre 10.

Na páxina web publícase o calendario das probas de avaliación aprobados oficialmente pola Xunta de Centro da EEAE http://aero.uvigo.es/gl/docencia/exames

Avaliación de segunda oportunidade:

O alumnado deberá realizar a segunda convocatoria de todos os contidos da materia, que suporá o 100% da nota, se a nota final da avaliación continua é inferior a 5 puntos sobre 10.

No caso de ter unha puntuación igual ou superior a 5 sobre 10 en todos os traballos/probas de avaliación continua, a cualificación quedará gardada para a segunda oportunidade, debendo presentarse só ao exame oficial, que terá un peso do 35% de a nota final da materia.

Avaliación de fin de carreira:

Para a avaliación de fin de carreira realizarase un exame na data oficial, que inclúe todos os contidos da materia. A nota do devandito exame para superar a materia será de 5 puntos sobre 10.

Uso de dispositivos móbiles:

Lembrase a todo o alumnado a prohibición do uso de dispositivos móbiles durante as avaliacións presenciais, de acordo co artigo 13.2.d) do Estatuto do Estudante Universitario, relativo aos deberes do alumnado universitario, que establece o deber de "absterse do uso ou da cooperación en procedementos fraudulentos durante as avaliacións, nos traballos ou nos documentos oficiais da universidade".

Uso da intelixencia artificial:

A IA está limitada en todas as avaliacións, tanto continuas como globais.

A IA está limitada en todas as actividades docentes.

Calquera persoa que utilice a IA en traballos académicos, científicos, creativos, administrativos ou de investigación debe declarar a ferramenta utilizada, a función realizada, o alcance da súa intervención e a parte do traballo que constitúe autoría humana.

As instrucións específicas sobre o seu uso en diversas actividades docentes e de avaliación serán comunicadas ao alumnado a través das canles de comunicación habituais do curso, preferentemente durante a presentación inicial do curso e a través

da plataforma en liña.

Detección de plagio:

No caso de detectar plaxio ou copia en calquera das avaliacións (continua ou global), a cualificación final será de SUSPENSO (0) e o asunto comunicarase á Administración do Centro para que tome as medidas oportunas.

Bibliografía. Fontes de información

Basic Bibliography

ESA, **ECSS standard**, ESA Requirements and Standards Division,

Naik Kshirasagar, Tripathy Priadarshi, **Software Testing and Quality Assurance**, 978-0-471-78911-6, Wiley, 2008

Clay Breshears, **The Art of Concurrency**, 978-0-596-52153-0, O□Reilly Media, Inc., 2009

Complementary Bibliography

varios, **Material de apoyo seleccionado**, fuentes diveras, 1960-2024

Recomendacións

Other comments

Recoméndase dedicar o tempo indicado de traballo persoal asignado, así como recorrer a titorías persoais cos docentes para resolver as posibles dúbidas que xurdan durante os estudos e a preparación de traballos.

Recoméndase un seguimento total da materia así como unha actitude activa nas clases e conferencias.

IDENTIFYING DATA				
Space telecommunication systems				
Subject	Space telecommunication systems			
Code	O07M197V01305			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Veiga López, Fernando			
Lecturers	Veiga López, Fernando			
E-mail	fernando.veiga@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	The subject "Space Telecommunication Systems" provides a comprehensive understanding of the technologies and systems used in space communication. First, it covers the study of radiofrequency and optical communication technologies, essential for data transmission in space. It delves into link budget, analyzing the necessary calculations to ensure effective communication between transmitters and receivers. Additionally, it examines the communication subsystems between ground stations and satellites, as well as the subsystems that enable inter-satellite communication. Satellite navigation systems are also covered. Another important aspect of the subject is the study of antennas, where the principles and specific designs for space communications are explored. The performance and applications of different types of antennas in satellites and ground stations are analyzed. Furthermore, the subject reviews radiofrequency systems and space electronics, fundamental for the design and operation of equipment in the space environment. Finally, the ground segment is considered, addressing the terrestrial infrastructure necessary to support space operations and the concept of operations, which includes the planning and management of space missions to ensure efficient and continuous communication. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject	Training and Learning Results
Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.	D11
To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.	C8

Contents	
Topic	
1.- Technologies and Link Analysis of Communications	1.- Radiofrequency, Optical Communications 2.- Link Budget 3.- Antennas
2.- Communication Subsystems - Space Segment	1.- Space-to-Earth Communication Subsystems 2.- Inter-Satellite Communication Subsystems
3.- Satellite Navigation Systems	1.- Basics of Satellite Navigation. 2.- Main Satellite Navigation Systems. 3.- Generation and Reception of Navigation Signals.
4.- Radio Systems and Space Electronics	1.- Architecture of Radio Systems. 2.- Space Environment Requirements in the Electronics of Radio Systems.
5.- Ground Segment	1.- Architecture 2.- Concept of Operations 3.- Operations Standards and Software

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	18	10	28
Problem solving	8	10	18
Autonomous problem solving	0	20	20
Laboratory practical	11	10	21
Practices through ICT	9.5	12	21.5
Objective questions exam	1.5	0	1.5
Essay	0	40	40
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation by the faculty of the contents on the subject under study, theoretical foundations, and guidelines for a project or exercise that the student has to develop.
Problem solving	Activity in which problems and/or exercises related to the subject are formulated. Students must develop appropriate solutions through the practice of routines, the application of formulas or algorithms, the application of procedures to transform the available information, and the interpretation of the results. This is usually used as a complement to the lecture.
Autonomous problem solving	Activity in which problems and/or exercises related to the subject are formulated. Students must develop the analysis and resolution of the problems and/or exercises independently.
Laboratory practical	Laboratory practices. Activities for applying knowledge to specific situations and acquiring basic and procedural skills related to the subject under study. These are conducted in specialized spaces with specialized equipment (laboratories, computer rooms, etc.).
Practices through ICT	Practices in computer labs. Activities for applying knowledge in a specific context and acquiring basic and procedural skills related to the subject, through ICT. Software used: Matlab, Python, Excel, STK (or similar).

Personalized assistance	
Methodologies	**Description**
Lecturing	Students will have the opportunity to attend personalized tutoring sessions in the professor's office during the hours established by the professors for this purpose at the beginning of the course, which will be published on the course webpage (https://moovi.uvigo.gal). They may also ask their questions via telematic means.
Problem solving	Students will have the opportunity to attend personalized tutoring sessions in the professor's office during the hours established by the professors for this purpose at the beginning of the course, which will be published on the course webpage (https://moovi.uvigo.gal). They may also ask their questions via telematic means.
Autonomous problem solving	Students will have the opportunity to attend personalized tutoring sessions in the professor's office during the hours established by the professors for this purpose at the beginning of the course, which will be published on the course webpage (https://moovi.uvigo.gal). They may also ask their questions via telematic means.
Laboratory practical	Students will have the opportunity to attend personalized tutoring sessions in the professor's office during the hours established by the professors for this purpose at the beginning of the course, which will be published on the course webpage (https://moovi.uvigo.gal). They may also ask their questions via telematic means.
Practices through ICT	Students will have the opportunity to attend personalized tutoring sessions in the professor's office during the hours established by the professors for this purpose at the beginning of the course, which will be published on the course webpage (https://moovi.uvigo.gal). They may also ask their questions via telematic means.

Assessment				
	Description	Qualification	Training and Learning Results	
Problem solving	Resolution of problems proposed during the sessions.	30	C8	D11
Laboratory practical	Preparation of a report by the students reflecting the characteristics of the work carried out. Students must describe the tasks and procedures developed, show the results obtained or the observations made, as well as the analysis and processing of the data.	20	C8	D11

Objective questions exam	A test in which students must solve a series of problems or exercises within a time and under conditions established by the professor. In this way, students must apply the knowledge they have acquired.	10	C8	D11
Essay	Work(s) on the entire content of the subject.	40	C8	

Other comments on the Evaluation

First Assessment Opportunity:

To pass the course in the first assessment opportunity, students must obtain a final grade of at least 5 out of 10 based on the combined evaluation of continuous assessment activities, assignments submitted throughout the course, and the examination taken on the official examination date. The final continuous assessment grade will be calculated according to the percentages indicated below.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution

Students have the right to opt for global assessment, following the procedure and deadline established by the faculty for each exam period.

Global assessment:

An exam will be held on the official date, covering all course content, including the topics and methods used in the case studies. A minimum score of 5 out of 10 on this exam is required to pass the subject.

The calendar of officially approved assessment tests by the EEAE Faculty Board is published on the website: http://aero.uvigo.es/gl/docencia/exames

Second-chance assessment:

Students must take the second-call exam covering all course content, which will account for 100% of the final grade, if the final continuous assessment grade is lower than 5 out of 10.

Final-year assessment:

For the final-year assessment, an exam will be held on the official date covering all course content. A minimum score of 5 out of 10 on this exam is required to pass the subject.

Sources of information

Basic Bibliography

Documentación del curso y transparencias,
Maral y Busquet, **Satellite Communications Systems: Systems, Techniques and Technology.**,
http://www.ecss.nl,
Teresa M. Braun, **Satellite Communications, Payload and System**,
Marcos Arias Acuña, Oscar Rubiños López, **Radiocomunicación**, Primera, Andavira Editora, 2011

Complementary Bibliography

John Griffits, **Radio Wave Propagation and Antennas. An Introduction**, Primera, Prentice Hall, 1985

Recommendations

Other comments

Dedicate the indicated amount of personal study time, and make use of personal tutoring sessions with the professor to resolve any doubts that arise during personal study.

A complete follow-up of the subject and an active attitude in classes are recommended.

IDENTIFYING DATA				
Space Observation Systems				
Subject	Space Observation Systems			
Code	O07M197V01306			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	González Jorge, Higinio			
Lecturers	González Jorge, Higinio Ríos Otero, Eduardo			
E-mail	higiniog@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	This subject provides an overview of the different observation systems used at satellite level, as well as their analogy at aeronautical, automotive or defense level English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject		
Expected results from this subject	Training and Learning Results	
Understanding of the different existing observation satellites and their main optical components	C8	D11
Understanding of the computer tools used for the processing of remote sensing satellite data	C8	D11
To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.	C8	
Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.		D11

Contents	
Topic	
1. Fundamentals of remote observation	- Fundamentals of remote sensing. - Satellites and sensors. - Satellite data processing levels. - Projections and coordinate systems. - Advantages and disadvantages of remote sensing. - Remote sensing technology
2. Optical sensors	- Fundamentals of remote sensing. - Satellites and sensors. - Satellite data processing levels. - Projections and coordinate systems. - Advantages and disadvantages of remote sensing. - Remote sensing technology.
3. Geometric optics	- Principles of geometric optics. - Planar and spherical diopter. - Plane and spherical mirror. - Thin lenses. - Multi-lens systems. - Magnifier and microscope - Telescope. - Photographic camera. - Optical aberrations.

4. LiDAR	- Active vs. passive sensors. - Distance determination. - Echoes. - Types of detectors. - LiDAR platforms (satellite and aerial). - Differences between LiDAR and RADAR. - LiDAR applications.
5. RADAR	- Pulsed RADAR. - CWFM RADAR. - Synthetic Aperture RADAR (SAR). - SAR imaging - SAR interaction with the earth's surface - Data preprocessing. - Applications.
6. SENTINEL Earth Observation Program	- Sentinel 1. - Sentinel 2. - Sentinel 3. - Sentinel 5.
7. Image processing	- Representation and basic treatments. - Transformations. - Geometric corrections. - Color corrections. - Radiometric corrections. - Edges. - Regions. - Points of interest extraction. - Edge description. - Region description. - Morphological operations. - Geometry and camera calibration.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Laboratory practical	16.5	0	16.5
Mentored work	0	102	102
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
Lecturing	Presentation of the contents of the subject through audiovisual media
Laboratory practical	Solving image processing problems using software tools such as Matlab and SNAP
Mentored work	Development of a project related to the design and implementation of a gimbal for the self-leveling of a digital camera-based observation system

Personalized assistance

Methodologies	Description
Laboratory practical	Classroom service. Tutoring by appointment. Attention by e-mail
Lecturing	Classroom service. Tutoring by appointment. Attention by e-mail
Mentored work	Classroom service. Tutoring by appointment. Attention by e-mail

Assessment

	Description	Qualification	Training and Learning Results	
Lecturing	Problem solving and exercises	35	C8	D11
Laboratory practical	Each practicum will define a deliverable that the student must send to the teacher before the deadline to the teacher before the indicated deadline	20	C8	D11
Mentored work	The student must submit a final report with the work done. In addition, he/she must make an exhibition of the work	40	C8	D11
Essay questions exam	Examination with developmental questions on the indicated topics	5	C8	D11

Other comments on the Evaluation

The student has the right to choose a comprehensive evaluation according to the procedure and deadlines established by the center for each exam period.

Continuous assessment tests will be conducted during course classes.

The official exam dates for all exam periods are used for the student to take a comprehensive exam on the subject if they do not follow continuous assessment or fail it. This exam will consist of a 50-question test, which will account for 100% of the subject grade and will have a duration of 2 hours. This same methodology will be used for the second opportunity and the final degree assessment

Grades for each part are not carried over between different exam periods.

AI not allowed in the performance of assessment tests.

The official calendar of assessment tests approved by the Center Board of the EEAE is published on the website: http://aero.uvigo.es/es/docencia/examenes/

Sources of information

Basic Bibliography

Emilio Chuvieco Salinero, **Teledetección ambiental: La observación de la Tierra desde el espacio**, 1st edition, Digital Reasons, 2023

Complementary Bibliography

JOHN A. RICHARDS , XIUPING JIA, **REMOTE SENSING DIGITAL IMAGE ANALYSIS**, 3rd edition, SPRINGER-VERLAG, 1999

FLOYD F. SABINS, **REMOTE SENSING: PRINCIPLES AND INTERPRETATION**, 1st edition, W. H. FREEMAN, 2005

Pierre-Philippe Mathieu, Christoph Aubrecht, **Earth Observation Open Science and Innovation**, 1st edition, SPRINGER, 2018

Recommendations

IDENTIFYING DATA				
Ciencias do espazo				
Subject	Ciencias do espazo			
Code	O07M197V01307			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2	1c
Teaching language	Castelán			
Department	Física aplicada			
Coordinator	Paredes Galán, Ángel			
Lecturers	Ferriz Mas, Antonio Lorenzo González, María de las Nieves Michinel Álvarez, Humberto Javier Paredes Galán, Ángel Salgueiro Piñeiro, José Ramón			
E-mail	angel.paredes@uvigo.es			
Web	http://webs.uvigo.es/muea			
General description	O curso "Ciencias do Espazo" para o máster en Enxeñaría Aeronáutica proporciona unha comprensión integral dos principios fundamentais e as aplicacións avanzadas no campo da exploración e tecnoloxía espacial. Iníciase cos Fundamentos da Relatividade Especial e Xeral, proporcionando unha base sólida nas teorías de Einstein que son cruciais para comprender o comportamento do espazo-tempo e a gravitación. Continuando, explóranse os conceptos de Gravitación, Relatividade e Aceleración de Naves Espaciais, onde se aplican estes principios ao deseño e operación de vehículos espaciais. O curso tamén inclúe Nocións de Astrofísica e Cosmoloxía, ofrecendo unha visión xeral do universo, os seus compoñentes e evolución. Ademais, abárcanse Nocións de Física do Espazo, enfocándose nos fenómenos físicos que ocorren na contorna espacial. En canto á tecnoloxía, estúdanse as Tecnoloxías Ópticas para o Espazo, esenciais para a observación e exploración espacial, e as Tecnoloxías Cuánticas para o Espazo, que representan o futuro da comunicación e navegación espacial avanzada.			

Resultados de Formación e Aprendizaxe	
Code	
C8	Deseñar produtos espaciais que se correspondan coas necesidades dos axentes implicados, definindo funcións, conceptos e a súa arquitectura.
D11	Comprender e aplicar os coñecementos, métodos e ferramentas necesarios para desenvolver proxectos de enxeñería espacial.

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results
Comprender e aplicar os coñecementos, métodos e ferramentas necesarios para desenvolver proxectos de enxeñería espacial	D11
Deseñar produtos espaciais que se correspondan coas necesidades dos axentes implicados, definindo funcións, conceptos e a súa arquitectura.	C8

Contidos	
Topic	
Tecnoloxías ópticas para o espazo	Telescopios espaciais Sistemas de imaxe Comunicacións ópticas
Tecnoloxías cuánticas para o espazo	Reloxos atómicos Comunicacións cuánticas
Introducción á relatividade especial	Fundamentos teóricos Efectos relativistas Espazo de Minkowski Aplicacións en ciencia e tecnoloxía espacial.
Introducción á relatividade xeral	Introducción histórica Fundamentos teóricos Fenómenos e predicción da relatividade xeral Aplicacións en ciencia e tecnoloxía espacial

Space weather	Estrutura do Sol Magnetismo solar A coroa e o vento solar A heliosfera e a magnetosfera terrestre Isótopos cosmoxénicos Tormentas xeomagnéticas
Nocións de astrofísica e cosmoloxía	A observación do espazo Espectroscopía Medida de distancias Tipos de estrelas e evolución estelar Tipos de galaxias O principio cosmológico Historia do Universo O fondo cósmico de microondas Modelos cosmolóxicos

Planificación

	Class hours	Hours outside the classroom	Total hours
Actividades introdutorias	1	0	1
Lección maxistral	19	0	19
Resolución de problemas	12	32	44
Resolución de problemas de forma autónoma	0	60	60
Prácticas de laboratorio	14	0	14
Exame de preguntas de desenvolvemento	2	0	2
Traballo	0	10	10
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente

	Description
Actividades introdutorias	Descríbense de modo xeral e en perspectiva os contidos da materia.
Lección maxistral	O profesor explica os principais conceptos dos contidos da materia
Resolución de problemas	O profesor expón problemas adecuados para a comprensión e aplicación dos conceptos básicos presentados na lección maxistral.
Resolución de problemas de forma autónoma	O alumnado utiliza os materiais da materia e os conceptos explicados en clase para resolver de forma autónoma problemas propostos deseñados para alcanzar os obxectivos de aprendizaxe e as competencias da materia.
Prácticas de laboratorio	Realízanse prácticas de laboratorio relacionadas con algúns conceptos da materia baixo a supervisión do profesorado.

Atención personalizada

Methodologies	**Description**
Actividades introdutorias	Resolveranse dúbidas e ofrecerase apoio ao alumnado tanto en clase como en titorías individualizadas.
Lección maxistral	Resolveranse dúbidas e ofrecerase apoio ao alumnado tanto en clase como en titorías individualizadas.
Resolución de problemas	Resolveranse dúbidas e ofrecerase apoio ao alumnado tanto en clase como en titorías individualizadas.
Resolución de problemas de forma autónoma	Resolveranse dúbidas e ofrecerase apoio ao alumnado tanto en clase como en titorías individualizadas.
Prácticas de laboratorio	Resolveranse dúbidas e ofrecerase apoio ao alumnado tanto en clase como en titorías individualizadas.
Tests	**Description**
Traballo	Resolveranse dúbidas e ofrecerase apoio ao alumnado tanto en clase como en titorías individualizadas.

Avaliación

	Description	Qualification	Training and Learning Results	
Resolución de problemas de forma autónoma	Entrega da resolución de problemas propostos. Ningún dos problemas superará o 40% da nota final da materia	50	C8	D11

Prácticas de laboratorio	Asistencia e traballo en prácticas e entrega de memoria de prácticas.	20	C8	D11
Exame de preguntas de desenvolvemento	Exame sobre os contidos da materia.	20	C8	D11
Traballo	Entrega dun traballo sobre un tema a elixir polo alumnado entre unha serie deles propostos polo profesorado.	10	C8	D11

Other comments on the Evaluation

Evaluacion de primeira oportunidade: Para superar a materia na 1º oportunidade requerirá obter unha calificación superior a 5 puntos sobre 10 na valoraciónconxunta das probas de evaluación continua, as entregas de traballos durante o desenvolvemento das clases, e o examerealizado na data oficial. A calificación final da evaluación continua obterase de acordo coas porcentaxes indicadas.O/A estudante ten dereito a optar pola evaluación global segun o procedemento e o prazo que estableza o centro para cadaconvocatoria.

Evaluación global: Realizarase un exame o día de a data oficial, que inclúe todos os contidos da materia, incluíndo os contidos e métodosutilizados nos casos de estudo. A calificación de devandito exame para superar a materia será de 5 puntos sobre 10.O calendario de probas de evaluación aprobado oficialmente pola Xunta de Centro dá EEAE publícase na webhttp://aero.uvigo.es/gl/docencia/exames

Evaluación da segunda oportunidade:O estudantado deberá presentarse ao exame de segunda convocatoria de todos os contenidos da materia, quesuporá ata o 100% de la nota. En cualquera caso e previo aviso ao coordinador da materia, cada estudante poderá conservaraquelas partes da nota de primeira oportunidade que desexe.

Evaluación de fin de carreira: Para a evaluación de fin de carreira, realizarase un exame na data oficial, que inclúe todos os contidos da materia. Acalificación de devandito exame para superar a materia será de 5 puntos sobre 10.

Bibliografía. Fontes de información

Basic Bibliography

Ray d'Inverno , James Vickers, **Introducing Einstein's Relativity: A Deeper Understanding**, OUP Oxford, 2022

Tim O'Brien, Jeffrey Forshaw, Helen Gleeson, Fred Loebinger, **Introduction to Astrophysics & Cosmology**, John Wiley & Sons Inc, 2024

B. K. Johnson, **Optics and Optical Instruments: An Introduction**, 3, Dover Publications, 2011

Shen-En Qian, **Optical Payloads for Space Missions**, John Wiley & Sons, Ltd., 2016

Vázquez Abeledo, M., **La historia del sol y el cambio climático**, McGraw-Hill Interamericana, 2003

Complementary Bibliography

Hamid Hemmati, **Deep Space Optical Communications**, Wiley-Interscience, 2006

Zheyu Jeff Ou, **Quantum optics for experimentalists**, World Scientific Publishing Company, 2017

Durante el curso se irá recomendando bibliografía adicional en forma de apuntes y artículos,

Recomendacións

IDENTIFYING DATA				
Sistemas de control órbita e actitude				
Subject	Sistemas de control órbita e actitude			
Code	O07M197V01308			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2	1c
Teaching language	Castelán Galego			
Department	Enxeñaría de sistemas e automática			
Coordinator	Balvís Outeiriño, Eduardo			
Lecturers	Balvís Outeiriño, Eduardo			
E-mail	ebalvis@uvigo.es			
Web	http://webs.uvigo.es/muea			
General description	A asignatura "Sistemas de Control de Órbita e Actitude" proporciona unha comprensión integral dos principios e técnicas utilizadas para estabilizar e dirixir vehículos espaciais. Os estudantes explorarán a dinámica orbital e de actitude, aprendendo a deseñar e analizar sistemas de control eficientes para manobras e estabilidade de satélites. Traballarase con sensores e actuadores específicos, así como con estratexias de control avanzado, a través de estudos de casos reais e simulacións prácticas.			

Resultados de Formación e Aprendizaxe	
Code	
C8	Deseñar produtos espaciais que se correspondan coas necesidades dos axentes implicados, definindo funcións, conceptos e a súa arquitectura.
D11	Comprender e aplicar os coñecementos, métodos e ferramentas necesarios para desenvolver proxectos de enxeñería espacial.

Resultados previstos na materia		
Expected results from this subject	Training and Learning Results	
Os estudantes serán capaces de comprender e aplicar os principios da mecánica orbital e a dinámica de actitude no control de vehículos espaciais. Serán capaces de analizar e deseñar sistemas de control que aseguren a estabilidade e o control tanto estático como dinámico dos vehículos espaciais.	C8	D11
Os estudantes adquirirán a capacidade de aplicar os coñecementos, métodos e ferramentas de enxeñería necesarios para o desenvolvemento e execución de proxectos espaciais, abordando problemas complexos e propoñendo solucións innovadoras.		D11
Os estudantes serán capaces de concibir e deseñar produtos espaciais que satisfagan as necesidades específicas dos diferentes axentes involucrados nun proxecto espacial. Isto inclúe a definición de funcións, conceptos e a arquitectura do sistema.	C8	

Contidos	
Topic	
1. Introdución e Modelado de Sistemas Espaciais	1.1 Introdución aos sistemas AOCS (Attitude & Orbit Control System) 1.2 Modelado matemático de sistemas dinámicos 1.3 Técnicas de simulación para a análise de sistemas de control espacial
2. Cinemática e Dinámica de Movemento 6-DOF	2.1 Cinemática de corpos ríxidos no espazo 2.2 Dinámica de translación e rotación 2.3 Técnicas de control para sistemas 6-DOF
3. Sistemas de Navegación e Sensores Inerciales	3.1 Navegación estelar (star-sight) e sistemas inerciales de navegación 3.2 Sistemas de navegación por radio (GPS, GNSS) 3.3 Tipos de sensores inerciales (giroscopios, acelerómetros) e as súas aplicacións
4. Estimación de Estados e Filtro de Kalman	4.1 Teoría da estimación de estados 4.2 Conceptos básicos de probabilidade e estatística 4.3 Implementación e aplicacións do filtro de Kalman
5. Teoría de Control e Control Óptimo	5.1 Fundamentos da teoría de control 5.2 Control óptimo e teoría da optimización 5.3 Aplicacións de control óptimo en sistemas AOCS

Planificación			
	Class hours	Hours outside the classroom	Total hours
Lección maxistral	22	0	22
Prácticas con apoio das TIC	18	0	18
Resolución de problemas	0	42	42
Estudo de casos	4	2	6
Seminario	2	0	2
Traballo tutelado	0	58	58
Resolución de problemas e/ou exercicios	2	0	2
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Lección maxistral	A lección maxistral consiste na exposición oral e estruturada dos contidos teóricos da materia por parte do profesor. Durante estas sesións, preséntanse e explican os conceptos fundamentais, teorías, e principios relacionados co control de órbita e actitude. Esta metodoloxía permite aos estudantes adquirir coñecementos sólidos e ben organizados sobre os temas tratados.
Prácticas con apoio das TIC	As prácticas con apoio das Tecnoloxías da Información e a Comunicación (TIC) implican o uso de software e ferramentas dixitais para a simulación, modelado e análise de sistemas de control de órbita e actitude. Estas prácticas permiten aos estudantes aplicar os coñecementos teóricos nunha contorna virtual e obter experiencia práctica con ferramentas utilizadas na industria.
Resolución de problemas	A metodoloxía de resolución de problemas implica que os estudantes se enfronten a exercicios e casos prácticos que deben resolver utilizando os coñecementos adquiridos. Este enfoque fomenta o pensamento crítico e analítico, e axuda aos estudantes a desenvolver habilidades para a identificación e solución de problemas complexos.
Estudo de casos	O estudo de casos implica a análise detallada de situacións reais ou hipotéticas relacionadas co control de órbita e actitude. Os estudantes examinan os casos, identifican problemas, e propoñen solucións baseadas nos coñecementos adquiridos. Esta metodoloxía permite conectar a teoría coa práctica e comprender o contexto real dos problemas.
Seminario	O seminario é unha metodoloxía interactiva na que se discuten e analizan temas específicos en profundidade. Durante estas sesións, os estudantes presentan e debaten temas, casos, ou artigos baixo a supervisión do profesor. Os seminarios fomentan a participación activa e o intercambio de ideas, e profundan no coñecemento de temas especializados.
Traballo tutelado	O traballo tutelado consiste na realización dun proxecto ou traballo de investigación baixo a supervisión do profesor. Os estudantes aplican os coñecementos adquiridos ao longo da materia para desenvolver un proxecto integral relacionado co control de órbita e actitude. Esta metodoloxía promove a autonomía, a creatividade e a capacidade de xestión de proxectos.

Atención personalizada	
Methodologies	**Description**
Lección maxistral	Atenderase aos estudantes durante a clase para aclarar dúbidas e en sesións de tutoría adicionais para unha comprensión máis profunda.
Prácticas con apoio das TIC	Atenderase aos estudantes en tempo real durante as prácticas para resolver calquera dificultade técnica e académica.
Resolución de problemas	Atenderase aos estudantes mediante consultas individuais durante e despois das clases, e proporcionaranse exercicios adicionais para practicar.
Estudo de casos	Atenderase aos estudantes durante discusións guiadas e ofrecerase asesoramento continuo sobre as análises e solucións propostas.
Seminario	Atenderase aos estudantes antes das presentacións para preparalos e proporcionarase retroalimentación detallada post-seminario.
Traballo tutelado	Atenderase aos estudantes con orientación continua e revisións periódicas, abordando consultas individuais sobre o progreso e calidade do proxecto.

Avaliación				
	Description	Qualification	Training and Learning Results	
Resolución de problemas	Realización de dúas probas para avaliar as competencias adquiridas. Estas probas poden incluír a aplicación de coñecementos á resolución de problemas concretos, exercicios de simulación, e análise de casos prácticos. Cada proba terá un peso dun 30% sobre a nota final da materia. Unha das probas realizarase na data oficial do exame final.	60	C8	D11

Traballo tutelado	Proba na que se expón un proxecto integral relacionado co control de órbita e actitude dun vehículo espacial. O alumno deberá desenvolver e presentar un proxecto aplicando os coñecementos adquiridos na materia. Este traballo entregarase na plataforma correspondente antes da data oficial do exame.	40	C8	D11

Other comments on the Evaluation

Avaliación de Primeira Oportunidade: Para superar a materia na primeira oportunidade, requírese obter unha cualificación superior a 5 puntos sobre 10 na valoración conxunta das probas de avaliación continua, as entregas de traballos durante o desenvolvemento das clases, e o exame realizado na data oficial. A cualificación final da avaliación continua obterase de acordo coas porcentaxes indicadas.

Avaliación Global: O estudante ten dereito a optar pola avaliación global segundo o procedemento e o prazo que estableza o centro para cada convocatoria. Realizarase un exame o día da data oficial, que inclúe todos os contidos da materia. A cualificación de dito exame para superar a materia será de 5 puntos sobre 10.

Avaliación de Segunda Oportunidade: O estudante deberá presentarse ao exame de segunda convocatoria de todos os contidos da materia, que suporá o 100% da nota, se a nota final de avaliación continua é menor que 5 puntos sobre 10. En caso de ter unha puntuación igual ou superior a 5 sobre 10 no conxunto dos traballos/probas de avaliación continua, gardarase a nota para la segunda oportunidade, tendo que presentarse unicamente ao exame oficial que terá un peso dun 30% sobre la nota final da materia.

Avaliación de Fin de Carreira: Para a avaliación de fin de carreira, realizarase un exame o día da data oficial, que inclúe todos os contidos da materia. A cualificación de dito exame para superar a materia será de 5 puntos sobre 10.

USO DE INTELIXENCIA ARTIFICIAL A IA está limitada nalgunhas probas de avaliación, tanto continuas como globais. A IA está recomendada en todas as actividades docentes. As probas nas que estea permitida a IA serán convenientemente notificadas por parte do PDI. Ademais, toda persoa que empregue IA en traballos académicos, científicos, creativos, administrativos ou de investigación deberá declarar a ferramenta utilizada, a función realizada, o alcance da súa intervención e a parte do traballo que constitúe autoría humana.

DETECCIÓN DE PLAXIO En caso de detección de copia ou plaxio en calquera das probas de avaliación (continua ou global), a cualificación final será de SUSPENSO (0) e o feito será comunicado á Dirección do Centro para os efectos oportunos.

Bibliografía. Fontes de información

Basic Bibliography

Kaplan, M. H., **Modern Spacecraft Dynamics and Control**, 1, Dover Publications, 2019

Brown, C. D., **Elements of Spacecraft Design**, 1, AIAA Education Series, 2003

Alexander Frias, **Modeling And Control Of Spacecraft Systems With Coupled Orbital And Attitude Dynamics**, 2021

Zhankui Zeng, Qi Zheng, Xu Zou, Lili Jiang, Zhineng Qing, Junjie Wu, Ran Wei, Wei Jiang, Yuzhu Wan, **Attitude control method for final substage orbital application subsystem**, 2020

Complementary Bibliography

Wertz, J. R., & Larson, W. J., **Space Mission Analysis and Design**, 3, Microcosm, 1999

James R. Forbes, Christopher Damaren, Anton H. de Ruiter, **Spacecraft Dynamics and Control: An Introduction**, 1, JOHN WILEY & SONS, 2013

Giorgio Fasano, Enrico Gaia, Stefano Ferroni, Mario Pessana, **End-to-end on-orbit servicing**, 2021

Recomendacións

IDENTIFYING DATA				
Space propulsion				
Subject	Space propulsion			
Code	O07M197V01309			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Ulloa Sande, Carlos			
Lecturers	Ulloa Sande, Carlos			
E-mail	carlos.ulloa@uvigo.es			
Web	http://webs.uvigo.es/muea			
General description	Space propulsion refers to any technology capable of propelling a spacecraft through space. To perform space travel, some propulsion system capable of providing acceleration to the vehicles is necessary. Rocket engines are the most commonly used for spacecraft propulsion because they generate enormous power and do not require atmospheric oxygen to operate. The course focuses primarily on electric space propulsion, the leading new technology for propulsion in space, both in Earth environment and inner solar system applications. English Friendly subject: International students may request from the faculty: a) materials and bibliographic references to follow the subject in English, b) tutorials in English, c) tests and evaluations in English.			

Training and Learning Results	
Code	
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
ID35. Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.	D11
ID36. Conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.	C8

Contents	
Topic	
BLOCK 1: General principles	1.1. Propulsion in space vehicles: propulsion figures of merit, propulsion requirements in space missions, rocket equation.
BLOCK 2: Chemical propulsion	2.1. Chemical propulsion: figures of merit in chemical rockets, nozzles, thrust coefficient, characteristic velocity. 2.2. Monopropellant (cold gas and hydrazine based rockets) and bipropellant rockets. 2.3. Propellant control units. Valves, pressure regulators and tanks. 2.4. Tank sizing: pressurizing gas, propellant and supercritical fluids.
BLOCK 3: Electric propulsion	3.1. Electric propulsion: plasma thrusters, plasma production and acceleration mechanisms, optimum specific impulse, missions with electric propulsion. 3.2. Principles of operation of ion and Hall thrusters. Quasineutrality. 3.3. Collisional processes. Dynamics of magnetized particles. 3.4. Ion grating thrusters: elements and electrical configurations, global model of the discharge chamber, grating model and expansion of the plasma jet, performance laws.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	30	0	30
Laboratory practical	8	0	8
Case studies	8	0	8
Mentored work	0	102	102

Essay questions exam	2	0	2

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Presentation by the teacher of the contents of the subject matter, theoretical bases and guidelines of a work or exercise that the student has to develop.
Laboratory practical	Computer laboratory. Activities of application of knowledge in a given context and acquisition of basic and procedural skills in relation to the subject, through ICT. Laboratory practices. Activities of application of knowledge to specific situations and acquisition of basic and procedural skills related to the subject matter. It is developed in special spaces with specialized equipment (laboratories, computer rooms, etc).
Case studies	Activity in which mini-projects related to the subject are formulated and the students must develop the appropriate solutions through the exercise of routines, the application of formulas or algorithms, the application of transformation procedures of the available information and the interpretation of the results. It is a complement to the lecturing class.
Mentored work	Group work where problems and/or exercises related to the subject are formulated. The students must develop the analysis and the resolution of the problems and/or exercises in an autonomous way.

Personalized assistance

Methodologies	Description
Lecturing	Classroom interaction. Tutoring by appointment. Attention by e-mail. Mail: carlos.ulloa@uvigo.gal
Laboratory practical	Classroom interaction. Tutoring by appointment. Attention by e-mail. Mail: carlos.ulloa@uvigo.gal
Case studies	Classroom interaction. Tutoring by appointment. Attention by e-mail. Mail: carlos.ulloa@uvigo.gal
Mentored work	Tutoring by appointment. Attention by e-mail. Mail: carlos.ulloa@uvigo.gal

Assessment

	Description	Qualification	Training and Learning Results	
Case studies	(*)Miniprojects durante todo o curso.	40	C8	D11
Mentored work	(*)Traballo en grupo	20	C8	D11
Essay questions exam	(*)Exame final na data aprobada polo centro	40	C8	D11

Other comments on the Evaluation

First call:

(1) Students following the course by Continuous Assessment:

In order to pass the course at the first opportunity, by Continuous Assessment, it will be necessary:

-A grade in the final exam of continuous assessment of, at least, a 3.5.

-Attend at least 80% of the practical sessions.

-Submit all the practical reports and assignments of the subject, obtaining, at least, a grade of 3 in each one of them.

In the case of not meeting these conditions, the final grade will be the result of the minimum of the average grade of EC and 4.9.

The continuous assessment tests will be carried out during school hours, whenever possible. The final continuous assessment exam will be held on the date approved by the center for the first call.

(2) Students who wish to be evaluated by exam-only assessment:

The evaluation of the course at the first call will be made, by default, through Continuous Assessment. The student body has the right to opt for the exam-only assessment according to the procedure and the period established by the center for each call, which may not exceed one month.

The grade obtained in this exam will represent 100% of the final grade. The student must obtain a minimum grade of 5.0 in this exam. This exam may have a part to be taken in a computer room and / or laboratory, and will cover the entire subject taught, as well as the contents covered in all practical sessions and assignments.

The exam-only assessment exam will be held on the date approved by the center for the first call.

Second call and end-of-program call:

Students who have not passed the subject at the first call and have waived the continuous assessment, may take an exam only assessment exam that will account for 100% of the final grade. The student must obtain a minimum grade of 5.0 in this exam. This exam may have a part to be taken in a computer room and / or laboratory, and will cover the entire subject taught, as well as the contents covered in all practical sessions and assignments. The student who has been evaluated by continuous assessment at the first call and has not waived it, will be re-evaluated for the final exam of Continuous Assessment and must meet the requirements to pass the subject by continuous assessment.

The second call and end-of-program assessment exam will be held on the dates approved by the center for each call.

Other considerations:

In case of detection of plagiarism in any qualification element, the qualification in said item will be 0 and the fact will be communicated to the direction of the Center for the appropriate effects.

The evaluation test schedule officially approved by the Board of the EEAE Center is published on the websitepublished on the website https://muea.webs.uvigo.es/gl/docencia/exames/.

Sources of information

Basic Bibliography

D. Goebel, I. Katz, **Fundamentals of electric propulsion**, Wiley, 2024

G.P. Sutton, O. Biblarz, **Rocket propulsion elements**, Wiley, 2001

Complementary Bibliography

G. Jahn, **Physics of electric propulsion**, Dover, 2006

Recommendations

Subjects that it is recommended to have taken before

Design, calculation and certification of aerospace propulsion systems/O07M197V01203

IDENTIFYING DATA				
Artificial Intelligence in Space Engineering				
Subject	Artificial Intelligence in Space Engineering			
Code	O07M197V01310			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Olivieri Cecchi, David Nicholas Rodríguez Liñares, Leandro			
Lecturers	Olivieri Cecchi, David Nicholas Rodríguez Liñares, Leandro			
E-mail	dnolivieri@gmail.com leandro@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	This course aims to educate the students on the fundamentals of artificial intelligence and its applications to the field of the aerospace engineering. The aim is to develop skills to be able to select, design and develop efficient solutions that allow to solve otherwise unsolvable problems. The aim is to empower students to develop code that harnesses the full potential of the application of artificial intelligence in the aerospace engineering. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
C8	To conceive spatial products that correspond to the needs of the agents involved, defining functions, concepts and their architecture.
D11	Understand and apply the knowledge, methods and tools necessary to develop space engineering projects.

Expected results from this subject	Training and Learning Results	
Understand and apply knowledge, methods and tools to develop projects of space engineering.	C8	D11
Develop space products that fulfill the needs of the involved agents, defining functions, concepts and its architecture.	C8	D11

Contents	
Topic	
Machine learning	Basics of supervised and no supervised learning Basic algorithms Advanced algorithms Artificial Intelligence in engineering
Neural networks (NNs)	CNNs, RNNs, transformers Generative Neural Networks Neural Networks in aerospacial engineering
Reinforcement learning	Basics of state learning with Bellman equation Q-learning Reinforcerment learning for the design, development and control of space systems
Other topics	PINNs: Partial differential equations with neural networks Other advanced topics Software quality in artificial intelligence and its verification and validation

Planning	Class hours	Hours outside the classroom	Total hours

Lecturing	29	0	29
Practices through ICT	10	0	10
Mentored work	0	102	102
Problem solving	6.5	0	6.5
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
Lecturing	Presentation by the teachers of the contents on the subjecti under study, the theoretical bases and guidelines.
Practices through ICT	Activities involving the application of knowledge to specific situations and the acquisition of basic skills and procedural abilities related to the subject under study using ICTs.
Mentored work	Activity in which problems and/or exercises related to the subject are formulated. The students have to work on the analysis and resolution of the problems and/or exercises in an autonomous way.
Problem solving	Activity with problems and/or exercises related with the subject. The students have to analyse and solve problems autonomously

Personalized assistance	
Methodologies	**Description**
Practices through ICT	Academic activity carried out by the teachers with the purpose of addressing the needs and inquiries of students related to their studies and/or topics related to the subject, providing guidance, support, and motivation in the learning process. Tutoring sessions can take place using online resources (email, video conferencing, Moovi forums, etc.) always with previous appointment.
Mentored work	Academic activity carried out by the teachers with the purpose of addressing the needs and inquiries of students related to their studies and/or topics related to the subject, providing guidance, support, and motivation in the learning process. Tutoring sessions can take place using online resources (email, video conferencing, Moovi forums, etc.) always with previous appointment.
Problem solving	Academic activity carried out by the teachers with the purpose of addressing the needs and inquiries of students related to their studies and/or topics related to the subject, providing guidance, support, and motivation in the learning process. Tutoring sessions can take place using online resources (email, video conferencing, Moovi forums, etc.) always with previous appointment.

Assessment				
	Description	Qualification	Training and Learning Results	
Practices through ICT	Problems and exercises used to verify if the students have achieved the training and learning results of the subject.	10	C8	D11
Mentored work	Work in which the students will apply the contents given in the subject to solve practical problems.	10	C8	D11
Problem solving	Problems used to verify if the students are able to apply the contents of the subject to practical problems.	40	C8	D11
Essay questions exam	Questionnaire composed by questions of different types to verify if the students reached the results of training and learning of the subject.	40	C8	D11

Other comments on the Evaluation

CONTINUOUS ASSESSMENT

PARTIAL EXAMS

Description: questionnaires conducted throughout the course

Applied Methodology: essay questions exam / problem solving

Weighting: 40%

Minimum required grade: a grade equal to or higher than 5 must be obtained

Assessed training and learning results: C8 D11

LAB ASSIGNMENTS:

Description: Practical exercises related to the contents

Applied Methodology: practices through ICT / mentored work

Weighting: 20%

Minimum required grade: a grade equal to or higher than 5 must be obtained

Assessed training and learning results: C8 D11

FINAL EXAM:

Description: final questionnaire consisting of different types of questions

Applied Methodology: essay questions exam / problem solving

Weighting: 40%

Minimum required grade: a grade equal to or higher than 5 must be obtained

Assessed training and learning results: C8 D11

- In all the methodologies/tests, a score equal to or greater than 5 points out of 10 must be obtained.
- Students must necessarily upload a ID-type photo to the profile of the Moovi platform in the first 2 weeks of the course.
- After the period for choosing the evaluation modality, students who carry out an evaluable activity, whatever the type, and who have not opted for the global evaluation system, will follow the continuous evaluation procedure described above.
- If a student does not show up for any of the evaluation activities, he/she will be assigned a grade of 0 in it.
- If a student abandons the continuous evaluation system having already been evaluated on some content of the subject, it will be considered that the he/she is suspended, and he/she will not be able to opt for the global evaluation system.

GLOBAL ASSESSMENT

FINAL EXAM:

Description: final questionnaire consisting of different types of questions

Applied Methodology: essay questions exam

Weighting: 100%

Minimum required grade: a grade equal to or higher than 5 must be obtained

Assessed training and learning results: C8 D11

Students who follow the global assessment procedure must take an exam with questions and exercises of various types in which they must obtain a grade greater than 5 out of 10 to pass.

EVALUATION CRITERIA FOR EXTRAORDINARY AND END OF CAREER EXAMS

The global evaluation system described above will be used.

QUALIFICATION PROCESS

To pass the subject it is ESSENTIAL to get a score equal to or greater than 5

ASSESSMENT DATES

The dates for the exams corresponding to the continuous assessment system will be published on the activity calendar, available on the faculty website

The official exam dates for the different exam periods, officially approved by the ESEI, are posted on the ESEI faculty website

USE OF MOBILE DEVICES

All students are reminded of the prohibition on the use of mobile or electronic devices and laptops in exercises and practices, in compliance with article 13.2.d) of the Statute of the University Student, regarding the duties of university students, which establishes the duty to refrain "from the use and cooperation in fraudulent procedures in the evaluation tests, in all academic assessments and reports, or in official documents of the university".

ACADEMIC FRAUD

All students are reminded that, according to article 3.2 of the Regulations for the Disciplinary Regime of the University of Vigo, the following will be considered very serious offences:

"e) Altering, falsifying, stealing or destroying academic documents or applications and computer systems of the University as well as using false documents or statements before the university.

...

i) Impersonate a person who is part of the university community in their own work or give consent to be impersonated, in relation to university activities."

It is also recalled that, according to the same Regulation, article 3.3, the following will be considered serious offenses:

"d) Committing academic fraud, when it does not constitute a very serious offense.

e) Improper use of content or means of reproduction and recording of university activities subject to intellectual property rights."

Article 3.5 indicates that "In accordance with the provisions of article 11. g) of the University Harmony Law, academic fraud is understood to be any premeditated behavior that tends to falsify the results of an exam or work, one's own or that of another, carried out as a requirement to pass a subject or accredit academic performance"

USE OF AI

The use of AI is limited to assignments and coursework that students complete outside the classroom. Students must specify how they used AI in these activities, and failure to do so will have a negative impact on their grade.

OFFICE HOURS

Office hours can be found on the personal pages of the teachers

Sources of information

Basic Bibliography

Aurélien Géron, **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow**, 3, O'Reilly Media, 2022

Andrew W. Trask, **Grokking Deep Learning**, 1, Manning, 2019

Edward Raff, **Inside Deep Learning: Math, Algorithms, Models**, 1, Manning, 2022

Graesser, L., & Keng, W. L., **Foundations of Deep Reinforcement Learning: Theory and Practice in Python**, 1, Pearson Education, Inc., 2020

Morales, M, **Deep Reinforcement Learning**, 1, Grokking, 2021

Goodfellow, I., Bengio, Y., Courville, A, **Deep Learning**, 1, The MIT Press, 2016

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Operation of air transport				
Subject	Operation of air transport			
Code	O07M197V01401			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Orgeira Crespo, Pedro			
Lecturers	Orgeira Crespo, Pedro			
E-mail	porgeira@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	The subject addresses the description of business activities in the operation of air transport, covering the applicable regulations and legislation, as well as the relevant legal, economic, and technical aspects. It studies the operational processes of air transport companies, including the production of supply through aircraft operations and the management of procedures and resources. Finally, it analyzes the economic outcomes, evaluating financial performance and operational efficiency within the context of the airline industry.			

Training and Learning Results	
Code	
B15	Adequate knowledge of air transport operations
B16	Understanding and mastery of the national and international aeronautical organization and the functioning of the different modes of the world transportation system, with special emphasis on air transportation.

Expected results from this subject	Training and Learning Results
ID28. Adequate knowledge of the operation of air transport.	B15
ID29. Understanding and mastery of national and international aeronautical organization and the functioning of the different modes of the global transport system, with special emphasis on air transport.	B16

Contents	
Topic	
Block 1. Description of the business activity related to the operation of air transport.	
Block 2. Regulations and rules applicable to air transport activities. Legal, economic, and technical aspects.	Topic 2.1 Introduction. Topic 2.2 Historical evolution. Topic 2.3 Main international agreements. Topic 2.4 ICAO. Topic 2.5 IATA. Topic 2.6 Liberalization of air transport.
Block 3. Operating process of air transport companies. Production of supply (aircraft operations) and management of procedures and resources.	Topic 3.1 Aircraft performance. Topic 3.2 Payload-range relationship. Topic 3.3 Fuel consumption. Topic 3.4 Energy efficiency. Topic 3.5 Utilization parameters. Topic 3.6 Airlines and other system components. Topic 3.7 Maintenance. Topic 3.8 Air transport safety.
Block 4. Economic results.	Topic 4.1 Introduction to the economic and financial analysis of the aviation industry. Topic 4.2 Air traffic forecasting. Topic 4.3 Revenues from air transport activities. Topic 4.4 Operating expenses. Topic 4.5 EBITDA.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	29	0	29
Problem solving	16.5	0	16.5
Essay	0	102	102
Objective questions exam	1.5	0	1.5
Objective questions exam	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
Lecturing	Presentation by the lecturer of the contents related to the subject matter under study, the theoretical foundations and/or the guidelines for an assignment or exercise that the student is required to carry out.
Problem solving	Activity in which problems and/or exercises related to the subject matter are presented. Students must develop the appropriate or correct solutions by practising routines, applying formulas or algorithms, applying procedures for transforming the available information, and interpreting the results. It is usually used as a complement to the lecture.

Personalized assistance

Tests	Description
Essay	

Assessment

	Description	Qualification	Training and Learning Results
Essay	Development of one or more assignments related to the subject content.	20	B15 B16
Objective questions exam	Exam consisting of problems and/or essay questions and/or multiple-choice questions.	40	B15 B16
Objective questions exam	Exam consisting of problems and/or essay questions and/or multiple-choice questions.	40	B15 B16

Other comments on the Evaluation

By default, the evaluation is assumed to be continuous. The student has the right to opt for the global evaluation according to the procedures and deadlines established by the center for each call.-

Continuous assesment:-

At the first exam call:

A partial, redeemable exam covering part of the course content will be held during the term. To pass this exam and be exempt from that portion of the course, a grade of 5 out of 10 is required. However, if the grade exceeds 4 out of 10, this portion can still be passed if the other sections of the course bring the overall final grade to at least 5 out of 10. The weight of this test in the final grade is 30%..

A final exam will be held on the official date set by the center. The written test will consist of two parts: a first part for students who passed the partial exam, with a weight of 40% in the final grade; and a second part, for students who did not pass the partial exam (with a weight of 30%)

A group (or indiividual) project will be conducted, contributing 30% to the final grade. Each member of the group may receive a different individual grade (in case of groupal project)

-

The minimum grade required in any test is 4 out of 10 in order to balance the exam and practicals. To pass the course, weighted grade of 5 out of 10 (including written exams and assignments) must be acheived. The written tests may consist of multiple-choice questions and/or short-answer questions and/or essay-type questions.

-

In the second exam call:

-

Students who have not passed the subject at the first call will take an exam that covers all aspects of the subject, on the official date indicated by the center.

-

To pass the course, a minimum grade of 5 out of 10 must be achieved. The exam may consist of test-type questions and/or short-answer questions and/or essay-type questions.

-

Exam-only assesment/End-of-program call:

-

A final exam will be held on the official date set by the center, which will cover all aspects of the subject.

-

To pass the course, a minimum grade of 5 out of 10 must be achieved. The exam may consist of test-type questions and/or short-answer questions and/or essay-type questions.

If plagiarism is detected in any graded item, a grade of 0 will be assigned for that item, and the incident will be reported to the Center's management for appropriate action.

During the tests, the use of watches, devices that emit or receive radio frequencies, mobile phones, or any other electronic devices is not permitted in the classroom, except for those expressly authorized by the school administration for medical reasons, according to the resolution corresponding to the request for students with special educational needs. During the tests, all students must keep their ears uncovered to ensure they are not using unauthorized devices.

If any student is found with unauthorized material during any test, whether copying, attempting to copy, or simply possessing the material in the classroom, it will be grounds for disciplinary action. After identification, the student will be asked to leave the classroom, and their final grade will be 0 points.

Sources of information

Basic Bibliography

Arturo Benito; Gustavo Alonso, **Transporte aéreo**, GARCETA, 2022

OACI, **Organización de Aviación Civil Internacional. Anexos Técnicos al Convenio de Chicago 1 a 19**, OACI,

Alejandro G. Gomez Artime, **Costes del Transporte Aereo Comercial**, 2, IBERIA, 1991

Complementary Bibliography

OACI, **Convenio sobre la Aviación Civil Internacional**, OACI, 1944

Recommendations

IDENTIFYING DATA				
Desenvolvemento de infraestructuras aeronáuticas				
Subject	Desenvolvemento de infraestructuras aeronáuticas			
Code	O07M197V01402			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán Galego			
Department	Enxeñaría mecánica, máquinas e motores térmicos e fluídos			
Coordinator	Rey González, Guillermo David			
Lecturers	García Luis, Uxía Orgeira Crespo, Pedro Rey González, Guillermo David			
E-mail	guillermo.rey@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	A materia abarca o emprazamento e plan de aeroportos, incluíndo o estudo para a súa localización. Profúndase no plan director e o deseño ambiental, así como na configuración da área de movemento de aeronaves e edificios aeroportuarios. Tamén se cobren proxectos de construción e mantemento de edificacións e instalacións, con énfases en infraestrutura eléctrica e control topográfico de obras. Finalmente, abórdase a certificación e xestión operativa de aeroportos, asegurando o cumprimento de normativas e a eficiencia na operación.			

Resultados de Formación e Aprendizaxe	
Code	
B17	Coñecemento adecuado das disciplinas de cartografía, xeodesia, topografía e xeotecnia, aplicadas ao deseño dun aeroporto e de todas as súas infraestruturas.
C7	Capacidade para a planificación, deseño, construción e xestión de aeroportos, e capacidade para o proxecto das súas instalacións eléctricas
D7	Capacidade para realizar a certificación aeroportuaria
D9	Competencia para planificar, proxectar, xestionar e certificar os procedementos, infraestruturas e sistemas de apoio á actividade aeroespacial, incluídos os sistemas de navegación aérea.
D10	Competencia para o proxecto de construcións e instalacións aeronáuticas e espaciais, que requiran dun proxecto conxunto integrado, pola diversidade das súas tecnoloxías, a súa complexidade ou os amplos coñecementos técnicos requiridos.

Resultados previstos na materia		
Expected results from this subject	Training and Learning Results	
ID27. Capacidade para a planificación, deseño, construción e xestionar aeroportos, e capacidade para o proxecto das súas instalacións eléctricas.	C7	
ID30. Coñecemento adecuado das disciplinas de cartografía, xeodesia, topografía e geotécnica, aplicadas ao deseño dun aeroporto e todas as súas infraestruturas.	B17	
ID31. Capacidade para levar a cabo a certificación de aeroportos.		D7
ID33. Competencia para planificar, proxectar, xestionar e certificar os procedementos, infraestruturas e sistemas que soportan a actividade aeroespacial, incluíndo os sistemas de navegación aérea.		D9
ID34. Competencia para o proxecto de construcións e instalacións aeronáuticas e espaciais, que requiran dun proxecto integrado conxunto, pola diversidade das súas tecnoloxías, a súa complexidade ou polos amplos coñecementos técnicos necesarios.		D10

Contidos	
Topic	
Bloque 1: Planificación do aeroporto. Plan director. Deseño ambiental do aeroporto.	Tema 1.1. Ordenación e regulación do sistema aeroportuario. Tema 1.2. Plans directores. Tema 1.3. Deseño ambiental.

Bloque 2: Construción das infraestruturas, edificacións e instalacións aeroportuarias. Dirección, control e vixilancia das obras. Topografía de control da obra.	
Bloque 3: Certificación e xestión de aeroportos.	
Bloque 4: Deseño da configuración do aeroporto. Área de movemento de aeronaves. Edificios do aeroporto e dos servizos de navegación aérea.	Tema 4.1. Características dos avións que afectan ao deseño de aeroportos. Tema 4.2. Configuración típica e código do aeroporto. Tema 4.3. Orientación, nome e configuración das pistas de aterraxe. Tema 4.4. Características das pistas de aterraxe. Tema 4.5. Características das rúas de rodaxe. Tema 4.6. Características das plataformas. Tema 4.7. Capacidade do aeródromo. Tema 4.8. Características da torre de control. Tema 4.9. Características da terminal. Tema 4.10. Heliportos.
Bloque 5: Emprazamento do aeroporto. Xeodesia, cartografía, topografía e xeotecnia aplicadas.	
Bloque 6: Proxectos aeroportuarios. Edificacións e área de movemento de aeronaves e as súas instalacións, en particular as eléctricas.	

Planificación

	Class hours	Hours outside the classroom	Total hours
Lección maxistral	29	0	29
Resolución de problemas	16.5	0	16.5
Traballo	0	102	102
Exame de preguntas de desenvolvemento	1.5	0	1.5
Presentación	1	0	1

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Metodoloxía docente

	Description
Lección maxistral	Exposición por parte do profesor dos contidos sobre a materia obxecto de estudo, bases teóricas e/o directrices dun traballo, exercicio que o/a estudante ten que desenvolver
Resolución de problemas	Actividade na que se formulan problema e/o exercicios relacionados coa materia. O alumno debe desenvolver as solucións idóneas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Adóitase empregar como complemento da lección maxistral.

Atención personalizada

Tests	Description
Traballo	O/A estudante, de maneira individual ou en grupo, elabora un documento sobre a temática da materia ou prepara seminarios, investigacións, memorias, ensaios, resumos de lecturas, conferencias, etc. No ámbito da acción titorial, distínguense accións de titoría académica, así como de titoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de titorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto etc. As titorías poden ser individualizadas, pero fomentaranse titorías grupais para a resolución de problemas relacionados coas actividades para realizar en grupo, ou simplemente para informar o docente da evolución do traballo colaborativo. Nas titorías personalizadas, cada alumno, de maneira individual, poderá comentar co profesor calquera problema que lle estea impedindo realizar un seguimento adecuado da materia, co fin de atopar entre ambos algúns tipos de solución. Conxugando ambos os tipos de acción titorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade.

Avaliación

	Description	Qualification	Training and Learning Results		
Traballo	Realización dun ou varios traballos relacionado cos contidos da materia.	40	B17	C7	D7 D9 D10
Exame de preguntas de desenvolvemento	Exame de problemas e/o preguntas de desenvolvemento e/o tipo test	40	B17	C7	D7 D9 D10

Presentación	Presentación e defensa en clase do traballo desenvolto.	20	B17	C7	D7 D9 D10

Other comments on the Evaluation

Convocatoria de primeira oportunidade.

(1) Estudantes que seguen o curso por Avaliación Continua.

Para poder superar a materia na primeira oportunidade, mediante Avaliación Continua, será necesario:

- Unha nota, no exame final de avaliación continua de, como mínimo, un 4.0.
- Asistir a, como mínimo, o 90% das sesións de prácticas.
- Entregar a totalidade de memorias prácticas e traballos dela materia obtendo, como mínimo, unha nota de 3 en cada un deles.

No caso de non cumprir devanditas condicións a nota final será a resultante do mínimo da nota media ponderada de EC e de 4.9.

(2) Estudante que desexen ser avaliados mediante avaliación global.

A avaliación do curso na primeira oportunidade realizarase, por defecto, mediante Avaliación Continua. O estudantado ten dereito a optar pola avaliación global segundo o procedemento e o prazo que estableza a universidade e o centro para cada convocatoria.

A nota obtida neste exame representará o 100% da nota final. O estudante deberá obter unha nota mínima de 5.0 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e/o laboratorio, e comprenderá a totalidade da materia impartida, así como os contidos abordados en todas as sesións prácticas e traballos.

Convocatoria de segunda oportunidade e fin de carreira.

O estudantado que non superase a materia na primeira oportunidade poderá realizarán un exame que supoñerá o 100% da nota. O estudante deberá obter unha nota mínima de 5.0 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e/o laboratorio,e comprenderá a totalidade da materia impartida, así como os contidos abordados en todas as sesións prácticas e traballos.

Uso de IA

Permítese o uso de ferramentas de Intelixencia artificial (IA) como apoio para a realización das actividades da materia, salvo que se indique expresamente o contrario. Cando se utilicen estas ferramentas, o estudantado deberá declarar sempre a súa utilización de forma explícita nos traballos entregados. En todo caso, será responsable do contido entregado e deberá poder xustificar a súa autoría e o proceso seguido para a súa elaboración. O uso destas tecnoloxías deberá acollerse en todo momento á normativa vixente da universidade de matrícula neste ámbito.

O profesorado poderá solicitar aclaracións, evidencias adicionais ou defensas individuais dos traballos realizados co fin de verificar a adquisición das competencias da materia. Nestas sesións individuais, o estudante deberá demostrar que comprendeu plenamente o contido do seu traballo e o proceso seguido para a súa elaboración.

Normas de aplicación nas probas presenciais.

Durante as probas, non se permite o uso de reloxos, dispositivos que emitan ou reciban radiofrecuencias, teléfonos móbiles nin ningún outro dispositivo electrónico na aula, salvo aqueles expresamente autorizados pola dirección do centro por motivos médicos, segundo a resolución correspondente á solicitude de adaptación de estudantes con necesidades educativas especiais. Durante as probas, todo o alumnado deberá manter os seus pavillóns auditivos despexados para comprobar que non utilizan dispositivos non autorizados.

No caso de que se detecte a algún alumno ou alumna con material non autorizado durante calquera proba, copiando, intentando copiar ou simplemente tendo o material na aula, será motivo de medida disciplinaria. Tras a identificación, pediráselle que abandone a aula e a súa cualificación final será de 0 puntos.

Copia ou plaxio

En caso de detección de copia e/o plaxio en calquera elemento de cualificación, a cualificación na devandita entrega será 0 e o feito será comunicado á dirección do Centro para os efectos oportunos.

Bibliografía. Fontes de información

Basic Bibliography

Seth Young, Alexander T. Wells, **Airport Planning & Management**, 9781260143324, 7, McGraw-Hill Education, 2019

Norman J. Ashford, Saleh Mumayiz, Paul H. Wright, **Airport Engineering: Planning, Design, and Development of 21st Century Airports**, 9780470398555, 4, John Wiley & Sons Inc, 2011

IATA, **Airport Handling Manual (AHM)**, 2024

IATA, **Ground Operations Manual**, 2024

Francisco Salazar De La Cruz, **Introducción a la gestion económica de aeropuertos**, 2, Fundación AENA, 2006

OACI, **Manual sobre los aspectos económicos de los aeropuertos**, 3, Organización de Aviación Civil Internacional, 2013

Comisión Europea, **Reglamento UE691/2010**, Comisión Europea,

Comisión Europea, **Reglamento de Ejecución UE2019/317**, Comisión Europea, 2019

Comisión Europea, **Reglamento de Ejecución UE2017/373**, Comisión Europea, 2017

Complementary Bibliography

Recomendacións

Subjects that are recommended to be taken simultaneously

Explotación do transporte aéreo/O07M197V01401

IDENTIFYING DATA				
Prácticas externas				
Subject	Prácticas externas			
Code	O07M197V01403			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2	2c
Teaching language	Castelán			
Department	Enxeñaría mecánica, máquinas e motores térmicos e fluídos			
Coordinator	Orgeira Crespo, Pedro			
Lecturers	Orgeira Crespo, Pedro			
E-mail	porgeira@uvigo.es			
Web	http://muea.webs.uvigo.es			
General description	Mediante a realización de prácticas externas o estudante poderá aplicar as competencias e coñecementos adquiridos ao longo dos seus estudos, permitindo reforzar a súa formación e facilitar a súa incorporación ao mercado laboral.			

Resultados de Formación e Aprendizaxe	
Code	
D12	Resolver situacións, problemas ou continxencias con iniciativa e autonomía no ámbito da competencia, con creatividade, innovación e espírito de mellora no traballo persoal e dos membros do equipo.

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results
Resolver situacións, problemas ou continxencias con iniciativa e autonomía no ámbito da competencia, con creatividade, innovación e espírito de mellora no traballo persoal e dos membros do equipo.	D12

Contidos	
Topic	
Realización de actividades ligadas ao desempeño profesional do Enxeñeiro Aeronáutico e das súas funcións máis habituais nunha contorna industrial real de empresa. Coñecemento xeral por parte do estudante do organigrama e das liñas de actividade da empresa ou institución.	- Visita ás instalacións. - Familiarización coa instrumentación, ferramentas, linguaxes de programación e paquetes de software usuais. - Asignación do estudante a un grupo de traballo. - Asignación ao estudante dun paquete de traballo concreto, correspondente a un dos traballos activos da empresa ou a unha das súas liñas de I+D+i, co seu correspondente cronograma. - Realización do traballo encomendado. - Redacción dunha memoria final sobre o traballo realizado. Entrega da documentación requirida xunto coa memoria final

Planificación			
	Class hours	Hours outside the classroom	Total hours
Prácticum, Practicas externas e clínicas	0	150	150
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente	
	Description
Prácticum, Practicas externas e clínicas	Realización das prácticas externas no organismo/empresa dentro do grupo de traballo e tarefa asignados

Atención personalizada	
Methodologies	**Description**
Prácticum, Practicas externas e clínicas	Os estudantes manterán contacto co coordinador académico da materia mediante envíoo regular de informes breves mediante emails, nos que informarán de calquera incidente que puidese existir e das tarefas realizadas na empresa. Recoméndase o envío semanal dos mesmos.

Avaliación

	Description	Qualification	Training and Learning Results
Prácticum, Practicas externas e clínicas	Avaliación por parte do titor da empresa durante o desenvolvemento das prácticas (25%) Autoavaliación do alumno (25%) Avaliación da memoria de prácticas entregada polo alumno ao finalizar a realización das mesmas(25%) Avaliación do informe do titor académico designado polo centro (25%) Os estudantes en prácticas deberán manter un contacto continuado non só co seu titor na empresa, senón tamén co seu titor académico. Ao concluír as prácticas, os alumnos deberán entregar ao seu titor académico unha memoria final e o informe en documento oficial Informe do estudante. Na avaliación terase en conta o seguimento realizado polo titor académico e os informes entregados polo alumno.	100	D12

Other comments on the Evaluation

A avaliación das prácticas en empresa rexerase polo establecido no regulamento específico da Escola de Enxeñería Aeronáutica e do Espazo para as prácticas externas das titulacións do centro. No seguimento e a avaliación das prácticas farase referencia ás competencias concretas, sobre todo entre as específicas, que se traballaron nas prácticas externas do estudante.

Bibliografía. Fontes de información

Basic Bibliography

Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Final Master's Project				
Subject	Final Master's Project			
Code	O07M197V01404			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	12	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Veiga López, Fernando			
Lecturers	Veiga López, Fernando			
E-mail	fernando.veiga@uvigo.gal			
Web	http://muea.webs.uvigo.es			
General description	The Master Thesis is an original and personal project that each student will carry out independently under the supervision of the teaching staff. It will allow the student to show the acquisition of knowledge and competences associated with the Master degree. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results
Code

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Contents	
Topic	
Knowledge, understanding, application, analysis and synthesis of a project in one of the following areas of aerospace engineering.	- Aerospace vehicles. - Propulsion systems. - Navigation and air traffic systems. - Airport engineering and aeronautical organisation.

Planning			
	Class hours	Hours outside the classroom	Total hours
Previous studies	0	90	90
Project based learning	0	120	120
Mentored work	20	0	20
Project	0	50	50
Presentation	1	19	20
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Previous studies	Autonomous work of study oriented to the acquisition of theoretical knowledges.
Project based learning	Work of the student oriented to the practical application.
Mentored work	On-site dedication of the student at the School of Aeronautical and Space Engineering facilities: -Student attendance at the school's laboratories for project development. -Tutorials with the tutor and/or co-tutor. Meetings with the student dedicated to the application of methods and techniques, document review, presentation rehearsals, etc.

Personalized assistance	
Methodologies	**Description**

Mentored work	On-site dedication of the student at the School of Aeronautical and Space Engineering facilities: -Student attendance at the school's laboratories for project development. -Tutorials with the tutor and/or co-tutor. Meetings with the student dedicated to the application of methods and techniques, document review, presentation rehearsals, etc.

Assessment

	Description	Qualification	Training and Learning Results
Project	Evaluation of the tutor: 25% Evaluation of the court: 50% - Qualification of the scope of the project. It will value the scientific/technical difficulty of the work (25%) - Qualification of the documentation. It will value the quality of the memory of EMT (25%)	75	
Presentation	Evaluation of the court: 25% - Qualification of the defence. They value appearances like the clarity in the presentation, employment of the time, quality of the material employed and reply the questions of the court.	25	

Other comments on the Evaluation

The Master Thesis is an original exercise that is carried out individually, presented and defended before a university tribunal, consisting of a project in the fields of aerospace vehicles, propulsion systems, navigation and air traffic systems, and/or airport engineering and aeronautical organisation, of a professional nature, in which the competences acquired in the courses taught in the Master's Degree are synthesised and integrated.

The completion and evaluation of the Master Thesis is regulated according to the current regulations of both the University of Vigo and the EEAE.

In case of detection of plagiarism in any of the tests (short tests, mid-term exams or final exam), the final grade will be FAILED.

The final grade will be FAILED (0) and the fact will be communicated to the management of the School for appropriate effects.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

Ethical commitment: it is expected that the student presents suitable ethical behaviour. In case any unethical behaviour is detected (copy, plagiarism or others) the global note in this course will be suspense (0,0).
Requirements: To enrol in the End of Master Thesis it is necessary to have surpassed or be enrolled in all the matters of the inferior courses up to the course in which it the EMT is found.
Important information: The EMT will only be possible to be defended and evaluated when there is proof that the student has surpassed all the necessary credits for obtaining the Master title, except the corresponding to the own EMT, according to the Regulation for the Realisation of the End of Master Thesis approved in the Council of Government on 15 June 2016 and modified on 13 November 2018 and 15 of october of 2022.
The originality of the thesis will be analysed through a computer application for the detection of plagiarism.

IDENTIFYING DATA				
Solid mechanics and aerospace structures				
Subject	Solid mechanics and aerospace structures			
Code	O07M197V01921			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	1st	1st
Teaching language				
Department				
Coordinator	Comesaña Piñeiro, Rafael Conde Carnero, Borja			
Lecturers	Comesaña Piñeiro, Rafael Conde Carnero, Borja Cruz Cadaya, Yago			
E-mail	bconde@uvigo.es racomesana@uvigo.es			

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IDENTIFYING DATA				
Fluid mechanics II and CFD				
Subject	Fluid mechanics II and CFD			
Code	O07M197V01922			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	1st	1st
Teaching language				
Department				
Coordinator	Suárez Porto, Eduardo			
Lecturers	Domínguez Estévez, Pablo Martín Ortega, Elena Beatriz Suárez Porto, Eduardo			
E-mail	suarez@uvigo.es			

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IDENTIFYING DATA				
Aerodinámica e aeroelasticidade				
Subject	Aerodinámica e aeroelasticidade			
Code	O07M197V01923			
Study programme	Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Optional	1	2c
Teaching language				
Department	Enxeñaría mecánica, máquinas e motores térmicos e fluídos			
Coordinator	García Luis, Uxía			
Lecturers	Castro Álvarez, Óscar García Luis, Uxía			
E-mail	uxia.garcia.luis@uvigo.gal			
Web				
General description				

Resultados de Formación e Aprendizaxe
Code

Resultados previstos na materia	
Expected results from this subject	Training and Learning Results

Contidos
Topic

Planificación			
	Class hours	Hours outside the classroom	Total hours
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Metodoloxía docente
Description

Atención personalizada

Avaliación		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation

Bibliografía. Fontes de información
Basic Bibliography
Complementary Bibliography

Recomendacións

IDENTIFYING DATA				
Mechanics of flight				
Subject	Mechanics of flight			
Code	O07M197V01924			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	1st
Teaching language	#EnglishFriendly Spanish English			
Department				
Coordinator	Orgeira Crespo, Pedro			
Lecturers	Orgeira Crespo, Pedro			
E-mail	porgeira@uvigo.es			

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IDENTIFYING DATA				
Space vehicles				
Subject	Space vehicles			
Code	O07M197V01933			
Study programme	(*)Máster Universitario en Enxeñería Aeronáutica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Ulloa Sande, Carlos			
Lecturers	Ulloa Sande, Carlos			
E-mail	carlos.ulloa@uvigo.es			

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