



## (\*)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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Campus universitario

32004 Ourense

Tel.: +34 988 368 823

Web: <http://aero.uvigo.es>

### Regulations and legislation

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

## Grado en Ingeniería Aeroespacial

### Subjects

#### Year 4th

| Code          | Name                                      | Quadmester | Total Cr. |
|---------------|-------------------------------------------|------------|-----------|
| 007G410V01701 | Proyect direction and management          | 1st        | 6         |
| 007G410V01901 | Navigational systems                      | 2nd        | 6         |
| 007G410V01903 | Materials for the aerospace industry      | 2nd        | 6         |
| 007G410V01904 | Systems in real time                      | 2nd        | 6         |
| 007G410V01905 | Meteorology                               | 2nd        | 6         |
| 007G410V01910 | Information management systems            | 2nd        | 6         |
| 007G410V01913 | Forming technology of aerospace materials | 2nd        | 6         |
| 007G410V01924 | Mechanics of flight                       | 1st        | 6         |
| 007G410V01934 | Fixed-wing and rotary wing aircrafts      | 1st        | 9         |

|               |                                                     |     |    |
|---------------|-----------------------------------------------------|-----|----|
| O07G410V01935 | Maintenance and certification of aerospace vehicles | 1st | 9  |
| O07G410V01944 | Control and optimization                            | 1st | 6  |
| O07G410V01945 | Propulsion systems                                  | 1st | 6  |
| O07G410V01946 | Aerospace Vehicles                                  | 1st | 6  |
| O07G410V01981 | Professional internships                            | 2nd | 6  |
| O07G410V01991 | Final Year Dissertation                             | 2nd | 12 |

| IDENTIFYING DATA                 |                                                                                                                               |           |      |            |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------|------|------------|
| Dirección e xestión de proxectos |                                                                                                                               |           |      |            |
| Subject                          | Dirección e xestión de proxectos                                                                                              |           |      |            |
| Code                             | 007G410V01701                                                                                                                 |           |      |            |
| Study programme                  | Grao en Enxeñaría Aeroespacial                                                                                                |           |      |            |
| Descriptors                      | ECTS Credits                                                                                                                  | Choose    | Year | Quadmester |
|                                  | 6                                                                                                                             | Mandatory | 4    | 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://aero.uvigo.es                                                                                                          |           |      |            |
| General description              | Esta materia aborda os aspectos técnicos, económico-financieros, legais e de xestión dos proxectos de enxeñaría aeroespacial. |           |      |            |

| Competencias |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A2           | Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo                                                                                                                                                                                                                           |
| A3           | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                                                                                                                                                                                                                                            |
| A4           | Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado como non especializado                                                                                                                                                                                                                                                                                                                                                          |
| A5           | Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                                                                                                                                                                                                                                                    |
| B1           | Capacidade para o deseño, desenvolvemento e xestión no ámbito da enxeñaría aeronáutica que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/308/2009, os vehículos aeroespaciais, os sistemas de propulsión aeroespacial, os materiais aeroespaciais, as infraestruturas aeroportuarias, as infraestruturas de *aeronavegación e calquera sistema de xestión do espazo, do tráfico e do transporte aéreo.                              |
| B2           | Planificación, redacción, dirección e xestión de proxectos, cálculo e fabricación no ámbito da enxeñaría aeronáutica que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/308/2009, os vehículos aeroespaciais, os sistemas de propulsión aeroespacial, os materiais aeroespaciais, as infraestruturas aeroportuarias, as infraestruturas de aeronavegación e calquera sistema de xestión do espazo, do tráfico e do transporte aéreo. |
| B4           | Verificación e Certificación no ámbito da enxeñaría aeronáutica que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/308/2009, os vehículos aeroespaciais, os sistemas de propulsión aeroespacial, os materiais aeroespaciais, as infraestruturas aeroportuarias, as infraestruturas de aeronavegación e calquera sistema de xestión do espazo, do tráfico e do transporte aéreo.                                                      |
| B5           | Capacidade para levar a cabo actividades de proxección, de dirección técnica, de peritación, de redacción de informes, de ditames, e de asesoramento técnico en tarefas relativas á Enxeñaría Técnica Aeronáutica, de exercicio das funcións e de cargos técnicos genuinamente aeroespaciais.                                                                                                                                                                                                  |
| B7           | Capacidade de analizar e valorar o impacto social e medioambiental das solucións técnicas.                                                                                                                                                                                                                                                                                                                                                                                                     |
| B8           | Coñecemento, comprensión e capacidade para aplicar a lexislación necesaria no exercicio da profesión de Enxeñeiro Técnico Aeronáutico.                                                                                                                                                                                                                                                                                                                                                         |
| C19          | Coñecemento aplicado de: a ciencia e tecnoloxía dos materiais; mecánica e termodinámica; mecánica de fluídos; aerodinámica e mecánica do voo; sistemas de navegación e circulación aérea; tecnoloxía aeroespacial; teoría de estruturas; transporte aéreo; economía e produción; proxectos; impacto ambiental.                                                                                                                                                                                 |
| D3           | Capacidade de comunicación oral e escrita na lingua nativa                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| D4           | Capacidade de aprendizaxe autónoma e xestión da información                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| D5           | Capacidade de resolución de problemas e toma de decisións                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| D6           | Capacidade de comunicación interpersoal                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| D8           | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| D11          | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                                                                                                                                                                                                                                              |
| D12          | Compromiso ético e democrático                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| D13          | Sustentabilidade e compromiso ambiental. Uso equitativo, responsable e eficiente dos recursos                                                                                                                                                                                                                                                                                                                                                                                                  |

| Resultados de aprendizaxe          |                               |
|------------------------------------|-------------------------------|
| Expected results from this subject | Training and Learning Results |

**Contidos**

## Topic

Tema 1. Dirección empresarial: función directiva.  
Xestión de recursos humanos e do coñecemento.

Tema 2. Xestión de Calidade. Xestión de  
Mercadotecnia.

Tema 3. Xestión económico-financeira da  
empresa.

Tema 4. Tipo de proxectos de enxeñaría.  
Planificación, avaliación e control dun proxecto.

Tema 5. Xestión do alcance, tempo, calidade,  
recursos humanos e comunicacións dun proxecto.  
Custo e risco.

Tema 6. Indicadores obxectivos do resultado dun  
proxecto.

Tema 7. Impacto ambiental de aeroportos,  
aerolíneas e instalacións aeronáuticas. Normativa

**Planificación**

|                                       | Class hours | Hours outside the<br>classroom | Total hours |
|---------------------------------------|-------------|--------------------------------|-------------|
| Lección maxistral                     | 32          | 63                             | 95          |
| Traballo tutelado                     | 9           | 15                             | 24          |
| Prácticas de laboratorio              | 9           | 18                             | 27          |
| Exame de preguntas de desenvolvemento | 2           | 0                              | 2           |
| Presentación                          | 0.5         | 1.5                            | 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 por parte do profesor/a dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio que o/a estudante ten que desenvolver.                                                                                                  |
| Traballo tutelado        | 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.                                                                                |
| Prácticas de laboratorio | Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedementais relacionadas coa materia obxecto de estudo. Desenvólvense en espazos especiais con equipamento especializado (Laboratorios, aulas informáticas, etc...) |

**Atención personalizada****Methodologies Description**

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lección maxistral | No ámbito da acción tutorial, distínguense accións de tutoría académica, así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupais para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías 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 tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Traballo tutelado** No ámbito da acción tutorial, distínguense accións de tutoría académica, así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupais para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías 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 tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade.

| <b>Avaliación</b>                     |                                                                         |               |                               |    |     |     |
|---------------------------------------|-------------------------------------------------------------------------|---------------|-------------------------------|----|-----|-----|
|                                       | Description                                                             | Qualification | Training and Learning Results |    |     |     |
| Prácticas de laboratorio              | Memoria de prácticas de laboratorio                                     | 25            | A2                            | B1 | C19 | D3  |
|                                       |                                                                         |               | A3                            | B2 |     | D4  |
|                                       |                                                                         |               | A5                            | B4 |     | D5  |
|                                       |                                                                         |               |                               | B5 |     | D8  |
|                                       |                                                                         |               |                               | B7 |     | D11 |
|                                       |                                                                         |               |                               | B8 |     | D13 |
|                                       |                                                                         |               |                               |    |     |     |
|                                       |                                                                         |               |                               |    |     |     |
| Exame de preguntas de desenvolvemento | Realización de probas parciais e dun exame final de avaliación continua | 50            | A2                            | B1 | C19 | D3  |
|                                       |                                                                         |               | A3                            | B2 |     | D4  |
|                                       |                                                                         |               | A5                            | B4 |     | D5  |
|                                       |                                                                         |               |                               | B5 |     | D11 |
|                                       |                                                                         |               |                               | B7 |     | D13 |
|                                       |                                                                         |               |                               | B8 |     |     |
|                                       |                                                                         |               |                               |    |     |     |
|                                       |                                                                         |               |                               |    |     |     |
| Presentación                          | Presentación en clase do traballo grupal desenvolvido.                  | 25            | A2                            | B1 | C19 | D3  |
|                                       |                                                                         |               | A3                            | B2 |     | D4  |
|                                       |                                                                         |               | A4                            | B4 |     | D5  |
|                                       |                                                                         |               | A5                            | B5 |     | D6  |
|                                       |                                                                         |               |                               | B7 |     | D8  |
|                                       |                                                                         |               |                               | B8 |     | D11 |
|                                       |                                                                         |               |                               |    |     | D12 |
|                                       |                                                                         |               |                               |    |     | D13 |

#### **Other comments on the Evaluation**

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>

#### **Primeira edición de actas**

##### **(1) Estudiantes que seguen o curso por Avaliación Continua:**

Para poder superar a materia na primeira edición de actas, mediante Avaliación Continua, será necesario:

- Unha nota, no exame final de avaliación continua, non inferior a 4.0.
- Entregar todas as prácticas e traballos da materia obtendo, como mínimo, unha nota de 3 en cada un deles.

No caso de non cumprir ditas condicións a nota final será a resultante do mínimo da nota media de EC e de 4.0.

##### **(2) Estudiante que, tras unha autorización por parte do profesorado, renuncien á Avaliación Continua:**

A avaliación do curso na primeira edición de acta realizarase, por defecto, mediante a Avaliación Continua.

Os estudantes que teñan unha xustificación poderán renunciar oficialmente á avaliación continua e realizar un só exame final, na data oficial. A nota obtida neste exame representará o 100% da nota final. O alumno deberá superar o 5 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

A renuncia á avaliación continua debe facerse durante o primeiro mes de clase. Durante este período, presentarse o xustificante ao coordinador da materia para a súa avaliación.

#### **Segunda edición de actas.**

Os alumnos que non superasen a materia na primeira edición de actas poderán realizarán un exame que supoñerá o 100% da nota. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

O Estatuto do Estudiante Universitario, establece que o estudante universitario ten o deber de "absterse da utilización ou

cooperación en procedementos fraudulentos nas probas de avaliación, nos traballos que se realicen ou en documentos oficiais da universidade". Por iso, espérase que o alumno teña un comportamento ético adecuado. Se se detectase un comportamento pouco ético durante o curso (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros), penalizarase ao alumno cunha nota de 0,0 na proba escrita ou entregable onde se detectase devandita fraude

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## **Bibliografía. Fontes de información**

### **Basic Bibliography**

Project Management Institute, **Guía de los Fundamentos Para la Dirección de Proyectos (guía del PMBOK)**, 6, Project Management Institute, 2017

Cindy Lewis, Carl Chatfield, Timothy Johnson, **Microsoft Project 2019 Step by Step**, Microsoft Press, 2019

Philip Kotler, **Fundamentos De Marketing**, 13, ADDISON-WESLEY, 2017

Montserrat Cabrerizo, **Gestión Económica y Financiera de la Empresa**, 2, Marcombo Formación, 2017

### **Complementary Bibliography**

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## **Recomendacións**

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## **Plan de Continxencias**

### **Description**

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===

Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID-19, a Universidade establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determinen, atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial.

Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dunha maneira mais áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado, e o profesorado, a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

#### **Escenario 1: Docencia mixta**

Debido á situación excepcional, #ante a imposibilidade de poder impartir a docencia dun modo totalmente presencial, utilizaranse medios virtuais tanto síncronas como asíncronas para a impartición das clases que sexan habilitadas pola Universidade de Vigo.

As prácticas serán entregadas polos estudantes e avaliadas empregando os recursos das plataforma de teledocencia dispoñible no seu momento.

As sesións de tutorización, tanto o nivel individual como o nivel de grupos poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, salgas/aulas/despachos virtuais proporcionadas pola Universidade de Vigo).

#### **Escenario 2: Docencia non-presencial**

Debido á situación excepcional, #ante a imposibilidade de poder impartir a docencia dun modo presencial, utilizaranse medios virtuais para a impartición das clases que sexan habilitadas pola Universidade de Vigo.

As prácticas serán entregadas polos estudantes e avaliadas empregando os recursos da plataforma de teledocencia dispoñible no seu momento.

As sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, salgas/aulas/despachos virtuais proporcionadas pola Universidade de Vigo).

=== ADAPTACIÓN DAS METODOLOXÍAS ===

As metodoloxías docentes que se manteñen principalmente cunha posible modificación temporal na planificación segundo situación concreta.

Non procede ningunha modificacións dos contidos para impartir.

Auméntase a bibliografía co material de elaboración propia (por exemplo, guías de traballo, vídeos e textos explicativos, problemas resoltos, etc.) para facilitar a auto-aprendizaxe.

=== ADAPTACIÓN DA AVALIACIÓN ===

As probas mantéñense coas súas ponderacións previstas.

| <b>IDENTIFYING DATA</b>     |                                                                                                                                                                                                                                                                      |          |      |            |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| <b>Navigational systems</b> |                                                                                                                                                                                                                                                                      |          |      |            |
| Subject                     | Navigational systems                                                                                                                                                                                                                                                 |          |      |            |
| Code                        | 007G410V01901                                                                                                                                                                                                                                                        |          |      |            |
| Study programme             | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                     |          |      |            |
| Descriptors                 | ECTS Credits                                                                                                                                                                                                                                                         | Choose   | Year | Quadmester |
|                             | 6                                                                                                                                                                                                                                                                    | Optional | 4th  | 2nd        |
| Teaching language           | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                                                                              |          |      |            |
| Department                  |                                                                                                                                                                                                                                                                      |          |      |            |
| Coordinator                 | González Jorge, Higinio                                                                                                                                                                                                                                              |          |      |            |
| Lecturers                   | González Jorge, Higinio<br>González de Santos, Luis Miguel                                                                                                                                                                                                           |          |      |            |
| E-mail                      | higiniog@uvigo.es                                                                                                                                                                                                                                                    |          |      |            |
| Web                         | http://aero.uvigo.es                                                                                                                                                                                                                                                 |          |      |            |
| General description         | This course expose the main procedures and systems used in aircraft navigation.<br>International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English. |          |      |            |

| <b>Competencies</b> |                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                |                                                                                                                                                                                                                                                                                                                                                                              |
| A2                  | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study                                                                                           |
| A3                  | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                                                                                                               |
| A5                  | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                                                                                                                 |
| B1                  | Capability for design, development and management in the field of aeronautical engineering (in according with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, aerospace propulsion systems, aerospace materials , airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems. |
| B6                  | Capability to participate in flight testing programs for take-off and landing distances, ascent speeds, loss speeds, maneuverability and landing capacities.                                                                                                                                                                                                                 |
| C19                 | Applied knowledge of: science and technology of materials; mechanics and thermodynamics; fluid mechanics; aerodynamics and flight mechanics; navigation and air traffic systems; aerospace technology; theory of structures; airborne transportation; economy and production; projects; environmental impact.                                                                |
| D3                  | Capability of oral and written communication in native language                                                                                                                                                                                                                                                                                                              |
| D4                  | Capability of autonomous learning and information management                                                                                                                                                                                                                                                                                                                 |
| D6                  | Capability for interpersonal communication                                                                                                                                                                                                                                                                                                                                   |
| D8                  | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                                                                                                          |
| D11                 | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                                                                                                                |

| <b>Learning outcomes</b>                                                                                                                                  |                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Expected results from this subject                                                                                                                        | Training and Learning Results                  |
| Understanding of the need for aircraft navigation systems                                                                                                 | A2 B1 C19 D3<br>A3 B6 D4<br>A5 D6<br>D8<br>D11 |
| Understanding of the theoretical foundations and operation of aircraft navigation systems.<br>Understanding of external agents that affect these systems. | A2 B1 C19 D3<br>A3 B6 D4<br>A5 D6<br>D8<br>D11 |
| Understanding of the methods to ensure the proper working of these systems.                                                                               | A2 B1 C19 D3<br>A3 B6 D4<br>A5 D6<br>D8<br>D11 |

| <b>Contents</b>                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 1. Introduction to aircraft navigation.                  | 1.1. Basic concepts of cartography and geodesy.<br>1.2. Aeronautical charts.<br>1.3. Aircraft navigation concept. Observed, estimated, radioelectric and autonomous navigation.<br>1.4. Terminology (heading, azimuth, magnetic declination, nautical mile, knot, foot, etc.).<br>1.5. The wind in the air navigation. Wind triangle.<br>1.6. Orthodromic route. Characteristics, parameters and equations.<br>1.7. Loxodromic route. Characteristics, parameters and equations.<br>1.8. The altimetry in air navigation. Standard atmosphere. Pressure, density and temperature. The barometric altimeter. |
| 2. Meteorology and aircraft navigation.                  | 2.1. VMC and IMC weather conditions. Visual and instrumental navigation. VFR and IFR flight rules.<br>2.2. Basic flight instruments.<br>2.3. Technical requirements for visual and instrumental flight.<br>2.4. Organization of the aeronautical meteorological service in Spain through AEMET.                                                                                                                                                                                                                                                                                                             |
| 3. Conventional navigation systems.                      | 3.1. Directional radio signals.<br>3.2. Route beacons.<br>3.3. Automatic direction finder (ADF).<br>3.4. Non-directional beacon (NDB).<br>3.5. High frequency omnidirectional radio beacon (VOR).<br>3.6. Long Range Navigation systems (LORAN and NavSat).                                                                                                                                                                                                                                                                                                                                                 |
| 4. RNAV navigation.                                      | 4.1. Three-dimensional navigation system. Course line computer.<br>4.2. Inertial navigation system (INS).<br>4.3. Doppler radar.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 5. Distance measuring equipment (DME).                   | 5.1. Frequencies<br>5.2. DME theory.<br>5.3. Specifications and errors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 6. Instrument landing system (ILS).                      | 6.1. Guide and locator information. Ground and on board systems.<br>6.2. Glide path. Ground and on board systems.<br>6.3. Distance information. Radio beacon. Ground and on board systems.<br>6.4. Compass radio beacons.<br>6.5. Visual information. VASIS system.<br>6.6 Category of the ILS.                                                                                                                                                                                                                                                                                                             |
| 7. Microwave landing system (MLS).                       | 7.1. MLS principles.<br>7.2. Ground system.<br>7.3. On board system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 8. RADAR.                                                | 8.1. Introduction.<br>8.2. Primary RADAR.<br>8.3. Secondary RADAR.<br>8.4. Meteorological RADAR.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 9. Global Navigation Satellite System (GNSS).            | 9.1. Principles of satellite navigation.<br>9.2. GNSS segments.<br>9.3. GNSS signals.<br>9.4. Operation of the GNSS system.<br>9.5. GPS, GLONASS, GALILEO and BEIDOU systems.<br>9.6. The future of the GNSS system.                                                                                                                                                                                                                                                                                                                                                                                        |
| 10. Air traffic control systems (ATC).                   | 10.1. Review of ATC systems.<br>10.2. Transponders<br>10.3. On board systems.<br>10.4. System operation<br>10.5. ADSB system.<br>10.6. Communications, navigation and surveillance in ATC.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 11. Traffic alert and collision avoidance system (TCAS). | 11.1. TCAS system.<br>11.2. TCAS operation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 12. Aircraft navigation and unmanned aerial vehicles.    | 12.1. Airspace.<br>12.2. Rules for unmanned aerial vehicles.<br>12.3. On board navigation systems in unmanned aerial vehicles.<br>12.4. Future trends in unmanned aerial vehicles.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 13. Aircraft navigation and safety.                      | 13.1. Governmental aeronautical safety agency (AESA).<br>13.2. Aircraft navigation services in Spain (ENAI). Air traffic management. Aeronautical information service (AIS).                                                                                                                                                                                                                                                                                                                                                                                                                                |

## Planning

|                       | Class hours | Hours outside the classroom | Total hours |
|-----------------------|-------------|-----------------------------|-------------|
| Lecturing             | 26          | 0                           | 26          |
| Practices through ICT | 26          | 0                           | 26          |
| Mentored work         | 0           | 98                          | 98          |

\*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 of the contents of the subject through audiovisual media.                                                                                                         |
| Practices through ICT | Problem solving through software tools such as Matlab, QGIS and Mission Planner.                                                                                             |
| Mentored work         | The student will perform a project that consist of designing, implementing and verifying a navigation system for an unmanned aircraft, based on the GNSS and the INS system. |

### Personalized assistance

| Methodologies         | Description                                                 |
|-----------------------|-------------------------------------------------------------|
| Lecturing             | Classroom attention. On-line tutorials. Attention by email. |
| Practices through ICT | Classroom attention. On-line tutorials. Attention by email. |
| Mentored work         | On-line tutorials. Attention by email.                      |

### Assessment

|                       | Description                                                                                                                                                                                                 | Qualification | Training and Learning Results |          |     |                             |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----------|-----|-----------------------------|
| Lecturing             | There will be two partial exams to test the theoretical content of the subject.<br>Each one will have a weight of 20% in the global mark of the subject. Each exam will consist of a total of 30 questions. | 40            | A2<br>A3<br>A5                | B1<br>B6 | C19 | D3<br>D4<br>D6<br>D8<br>D11 |
| Practices through ICT | Each practice will define a deliverable that the student must send to the professor before the indicated deadline.                                                                                          | 40            | A2<br>A3<br>A5                | B1<br>B6 | C19 | D3<br>D4<br>D6<br>D8<br>D11 |
| Mentored work         | The student must deliver a final report with the work done.<br>In addition, the student must perform a presentation.                                                                                        | 20            | A2<br>A3<br>A5                | B1<br>B6 | C19 | D3<br>D4<br>D6<br>D8<br>D11 |

### Other comments on the Evaluation

The official exam dates are used for the student to take a global exam of the subject if he/she does not follow the continuous evaluation. This exam will consist of a 100-question test. The mark will correspond to 100% of the subject.

Marks from each of the parties are not kept between different exams.

The schedule of assessment tests officially approved by the EEAE is published on the website:

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

### Sources of information

#### Basic Bibliography

Mike Tooley and David Wyatt, **Aircraft communications and navigation systems**, Elsevier, 2007  
Eduardo Huerta, Aldo Mangiaterra y Gustavo Noguera, **GPS. Posicionamiento satelital**, UNR Editora, 2005  
Myron Kayton and Walter R. Fried, **Avionics navigation systems**, Wiley, 1997

#### Complementary Bibliography

Robert Arán Escuer y J. R. Aragoneses Manso, **Sistemas de navegación aérea**, Paraninfo, 1983

### Recommendations

#### Subjects that it is recommended to have taken before

Systems engineering and aerospace communications/O07G410V01925

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## **Contingency plan**

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### **Description**

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In prevention of a health alert caused by COVID-19, the following is established:

Theoretical, practical teaching and tutoring for students are planned to migrate if necessary to 100% virtual teaching, without the need for a physical presence in the classroom.

The evaluation tests will be carried out virtually using the FAITIC and Remote Campus tools.

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| IDENTIFYING DATA                        |                                                                                                                                                                                                |          |      |            |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Materiais para a industria aeroespacial |                                                                                                                                                                                                |          |      |            |
| Subject                                 | Materiais para a industria aeroespacial                                                                                                                                                        |          |      |            |
| Code                                    | 007G410V01903                                                                                                                                                                                  |          |      |            |
| Study programme                         | Grao en Enxeñaría Aeroespacial                                                                                                                                                                 |          |      |            |
| Descriptors                             | ECTS Credits                                                                                                                                                                                   | Choose   | Year | Quadmester |
|                                         | 6                                                                                                                                                                                              | Optional | 4    | 2c         |
| Teaching language                       | Castelán<br>Galego                                                                                                                                                                             |          |      |            |
| Department                              | Enxeñaría dos materiais, mecánica aplicada e construción                                                                                                                                       |          |      |            |
| Coordinator                             | Guitián Saco, María Beatriz                                                                                                                                                                    |          |      |            |
| Lecturers                               | Guitián Saco, María Beatriz                                                                                                                                                                    |          |      |            |
| E-mail                                  | bea.guitian@uvigo.es                                                                                                                                                                           |          |      |            |
| Web                                     | http://dept05.webs.uvigo.es/                                                                                                                                                                   |          |      |            |
| General description                     | Esta materia é unha introdución á ciencia dos materiais. O obxectivo é ofrecer ao alumnado unha visión xeral dos distintos tipos de materiais, as súas propiedades e aplicacións fundamentais. |          |      |            |

| Competencias |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| A2           | Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo                                                                                                                                                                                              |
| A3           | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                                                                                                                                                                                                               |
| A5           | Que os estudantes desenvolven aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                                                                                                                                                                                                                         |
| B1           | Capacidade para o deseño, desenvolvemento e xestión no ámbito da enxeñaría aeronáutica que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/308/2009, os vehículos aeroespaciais, os sistemas de propulsión aeroespacial, os materiais aeroespaciais, as infraestruturas aeroportuarias, as infraestruturas de *aeronavegación e calquera sistema de xestión do espazo, do tráfico e do transporte aéreo. |
| C20          | Coñecemento adecuado e aplicado á Enxeñaría de: A mecánica de fractura do medio continuo e as formulacións dinámicas, de fatiga de inestabilidade estrutural e de aeroelasticidad.                                                                                                                                                                                                                                                                                |
| D3           | Capacidade de comunicación oral e escrita na lingua nativa                                                                                                                                                                                                                                                                                                                                                                                                        |
| D4           | Capacidade de aprendizaxe autónoma e xestión da información                                                                                                                                                                                                                                                                                                                                                                                                       |
| D5           | Capacidade de resolución de problemas e toma de decisións                                                                                                                                                                                                                                                                                                                                                                                                         |
| D6           | Capacidade de comunicación interpersoal                                                                                                                                                                                                                                                                                                                                                                                                                           |
| D8           | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                                                                                                                                                    |
| D11          | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                                                                                                                                                                                                                 |
| D13          | Sustentabilidade e compromiso ambiental. Uso equitativo, responsable e eficiente dos recursos                                                                                                                                                                                                                                                                                                                                                                     |

| Resultados de aprendizaxe                                                                                                                                                |    |    |                               |     |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|-------------------------------|-----|--|
| Expected results from this subject                                                                                                                                       |    |    | Training and Learning Results |     |  |
| Coñecemento e comprensión dos Materiais para aplicacións Aeroespaciais: capacidade de identificar as súas diferenzas.                                                    | A2 | B1 | C20                           | D3  |  |
|                                                                                                                                                                          | A3 |    |                               | D4  |  |
|                                                                                                                                                                          | A5 |    |                               | D5  |  |
|                                                                                                                                                                          |    |    |                               | D6  |  |
|                                                                                                                                                                          |    |    |                               | D8  |  |
| Coñecemento xeral dos distintos materiais non metálicos utilizados na enxeñaría, como son os materiais poliméricos, os materiais cerámicos, os materiais compostos, etc. |    |    |                               | D11 |  |
|                                                                                                                                                                          |    |    |                               | D13 |  |
|                                                                                                                                                                          | A2 | B1 | C20                           | D3  |  |
|                                                                                                                                                                          | A3 |    |                               | D4  |  |
|                                                                                                                                                                          | A5 |    |                               | D5  |  |
|                                                                                                                                                                          |    |    |                               | D6  |  |
|                                                                                                                                                                          |    |    |                               | D8  |  |
|                                                                                                                                                                          |    |    |                               | D11 |  |
|                                                                                                                                                                          |    |    |                               | D13 |  |

|                                                                                                                |    |    |     |     |
|----------------------------------------------------------------------------------------------------------------|----|----|-----|-----|
| Coñecemento e comprensión dos Materiais para aplicacións Aeroespaciais: métodos de fabricación e optimización. | A2 | B1 | C20 | D3  |
|                                                                                                                | A3 |    |     | D4  |
|                                                                                                                | A5 |    |     | D5  |
|                                                                                                                |    |    |     | D6  |
|                                                                                                                |    |    |     | D8  |
|                                                                                                                |    |    |     | D11 |
|                                                                                                                |    |    |     | D13 |

## Contidos

| Topic                                                                     |                                                                                                                          |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Tema 1. Aliaxes de uso aeroespacial.                                      | Aliaxes lixeiras e superaleaciones. Fabricación e optimización de aliaxes. Propiedades mecánicas e térmicas das aliaxes. |
| Tema 2. Materiais Compostos.                                              | Clasificación. Procesos de fabricación de materiais compostos. propiedades mecánicas e térmicas dos materiais.           |
| Tema 3. Comportamento e fallo en servizo de materiais aeroespaciais (I).  | Fricción e desgaste. Fraxilización. Fractura. Corrosión e degradación. Fatiga. Termofluencia.                            |
| Tema 4. Comportamento e fallo en servizo de materiais aeroespaciais (II). | Análise de fallos. Técnicas de detección e inspección de fallos.                                                         |
| Tema 5. Unións mecánicas e adhesivas.                                     | Unión mecánica. Soldadura. Adhesivos. Unións híbridas.                                                                   |
| Tema 6. Certificación de estruturas aeronauticas.                         | Seguridade operacional. Mantemento.                                                                                      |

## Planificación

|                                           | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------|-------------|-----------------------------|-------------|
| Lección maxistral                         | 24.5        | 61.25                       | 85.75       |
| Prácticas de laboratorio                  | 10          | 30                          | 40          |
| Resolución de problemas de forma autónoma | 5           | 7.25                        | 12.25       |
| Saídas de estudo                          | 8           | 0                           | 8           |
| Exame de preguntas obxectivas             | 2           | 0                           | 2           |
| Presentación                              | 0.5         | 1.5                         | 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 por parte do profesor dos contidos da materia.           |
| Prácticas de laboratorio                  | Actividades para a aplicación práctica dos coñecementos adquiridos. |
| Resolución de problemas de forma autónoma | Resolución de problemas e exercicios relacionados coa materia.      |
| Saídas de estudo                          | Visitas en grupo reducido a empresas do sector aeronáutico.         |

## Atención personalizada

| Methodologies                             | Description                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prácticas de laboratorio                  | Tempo no que o profesor axuda ao alumno a resolver e realizar as actividades expostas nas prácticas de laboratorio.                                                 |
| Resolución de problemas de forma autónoma | Orientación que o profesorado presta ao alumnado para o desenvolvemento correcto dos problemas expostos.                                                            |
| Lección maxistral                         | Atención que o profesorado presta de maneira individual ao alumnado para resolver as dúbidas e dificultades que este atope na compresnsión dos contidos da materia. |

## Avaliación

|                          | Description                                                                                              | Qualification | Training and Learning Results |    |     |     |
|--------------------------|----------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|-----|-----|
| Prácticas de laboratorio | Informes da realización de prácticas que o alumno/a deberá entregar de maneira individual ou por grupos. | 20            | A2                            | B1 | C20 | D4  |
|                          |                                                                                                          |               | A3                            |    |     | D5  |
|                          |                                                                                                          |               | A5                            |    |     | D6  |
|                          |                                                                                                          |               |                               |    |     | D8  |
|                          |                                                                                                          |               |                               |    |     | D11 |
|                          |                                                                                                          |               |                               |    |     | D13 |

|                               |                                                                                                                   |    |                |    |     |                                    |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------|----|----------------|----|-----|------------------------------------|
| Exame de preguntas obxectivas | Proba escrita individual na que o/a alumno/a deberá responder a cuestións relativas á materia presentada na aula. | 60 | A2<br>A3<br>A5 | B1 | C20 | D3<br>D4<br>D5<br>D8<br>D11<br>D13 |
| Presentación                  | Presentación oral por grupos dun tema proposto durante o desenvolvemento da materia.                              | 20 | A2<br>A3<br>A5 | B1 | C20 | D3<br>D4<br>D5<br>D6<br>D8<br>D11  |

### Other comments on the Evaluation

Os datos correspondentes a horarios, aulas e datas de exames poderán consultarse de forma actualizada na páxina web do centro: <http://aero.uvigo.es/gl/docencia/examenes>

Para aprobar a materia nesta convocatoria será necesario acadar como mínimo o 40% da nota máxima en cada unha das probas avaliadas. De non alcanzarse devandito 40% nalguna proba, a nota final estará limitada por 4.9  
Queda prohibido o uso de calquera tipo de dispositivo electrónico durante as probas de avaliación, salvo autorización expresa. O feito de introducir calquera dispositivo non autorizado na aula durante a proba de avaliación será considerado motivo de non superación da materia. Nese caso o alumno obterá a calificación de 0 (suspense).

Avaliación para non asistentes: a nota será a dun exame final para avaliar todas as competencias asignadas á materia. A duración máxima do examen será de 2,5 horas, independentemente da convocatoria.

### Bibliografía. Fontes de información

#### Basic Bibliography

Donald R. Askeland, **Ciencia e ingeniería de los materiales**, 6ª, Cengage Learning, 2012

William F. Smith, **Fundamentos de la Ciencia e Ingeniería de los Materiales**, 4ª, McGraw-Hill, 2014

#### Complementary Bibliography

A. Brent, **Plastics. Materials and processing**, 3ª, Pearson Prentice Hall, 2006

J. Antonio Pero-Sanz, **Ciencia e ingeniería de materiales. Estructura, transformaciones, propiedades y selección**, 5ª, CIE-Dossat 200, 2000

Michael F. Ashby, **Materiales para ingeniería 1. Introducción a las propiedades, las aplicaciones y el diseño**, 1ª, Reverté, 2008

Michael F. Ashby, **Materiales para ingeniería 2. Introducción a la microestructura, el procesamiento y el diseño**, 1ª, Reverté, 2009

Prasad, N.E., **Aerospace materials and Materials technologies**, 1, Springer, 2017

### Recomendacións

#### Subjects that it is recommended to have taken before

Ciencia e tecnoloxía dos materiais/O07G410V01304

Resistencia de materiais e elasticidade/O07G410V01405

Fabricación aeroespacial/O07G410V01501

Materiais para a industria aeroespacial/O07G410V01903

### Plan de Continxencias

#### Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===

Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID- 19, a Universidade establece una planificación extraordinaria que se activará no momento en que as administracións e a propia institución o determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun xeito máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

\* Metodoloxías docentes que se modifican:

A docencia non presencial terá lugar mediante actividades síncronas e asíncronas reforzando tanto o emprego da plataforma Fatic como o uso das aulas virtuais do Campus Remoto, de xeito que o alumnado poida acadar sen problema as competencias prefixadas, co menor cambio posible respecto á docencia presencial.

\* Mecanismo no presencial de atención al alumnado (tutorías):

As titorías realizaránse a través dos medios telemáticos dispoñibles na Universidade de Vigo empregando de xeito preferente o despacho virtual do profesor da materia.

\* Modificacións (se proceden) dos contidos a impartir:

No se contemplan modificacións nos contidos xerais da materia.

\* Bibliografía adicional para facilitar a auto-aprendizaxe:

Ademais das fontes de información reflectidas na guía docente, incluírase material de consulta adicional como extractos de capítulos de libros así como distintos enlaces de contido audiovisual relacionados con cada tema para complementar a información aportada en cada tema.

### === ADAPTACIÓN DE LA EVALUACIÓN ===

Debido a imposibilidade de garantir a posibilidade de realizar probas presenciais durante o curso, realízase unha modificación do sistema de avaliación da guía docente, co obxectivo de poder realizar o 100% da avaliación da materia mediante probas de carácter non presencial. Estas realizaranse por medio de distintos medios telemáticos dispoñibles ao longo do cuadrimestre.

Sistema de avaliación modificado:

Prácticas de laboratorio, informes da realización de prácticas que o alumno/a deberá entregar de maneira individual ou por grupos cun 20% na nota final.

Exame de preguntas obxectivas, proba escrita individual na que o/a alumno/a deberá responder a cuestións relativas á materia presentada na aula cun 40% na nota final.

Cuestionarios ou resolución de problemas de xeito individual con 20% na nota final.

Presentación oral individual ou por grupos dun tema proposto durante o desenvolvemento da materia cun 20% na nota final.

O estudante que renuncie á avaliación continua mediante ás distintas probas de avaliación, terá dereito á realización dunha proba final onde poderá acadar o 100% da calificación total da materia.

\* Información adicional

Os datos correspondentes a horarios, aulas e datas de exames poderán consultarse de forma actualizada na páxina web do centro: <http://aero.uvigo.es/gl/docencia/exames>

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| <b>IDENTIFYING DATA</b>     |                                                                                                                                                                                                                                                                                                                                        |          |      |            |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| <b>Systems in real time</b> |                                                                                                                                                                                                                                                                                                                                        |          |      |            |
| Subject                     | Systems in real time                                                                                                                                                                                                                                                                                                                   |          |      |            |
| Code                        | 007G410V01904                                                                                                                                                                                                                                                                                                                          |          |      |            |
| Study programme             | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                       |          |      |            |
| Descriptors                 | ECTS Credits                                                                                                                                                                                                                                                                                                                           | Choose   | Year | Quadmester |
|                             | 6                                                                                                                                                                                                                                                                                                                                      | Optional | 4th  | 2nd        |
| Teaching language           | #EnglishFriendly<br>Spanish                                                                                                                                                                                                                                                                                                            |          |      |            |
| Department                  |                                                                                                                                                                                                                                                                                                                                        |          |      |            |
| Coordinator                 | Orgeira Crespo, Pedro                                                                                                                                                                                                                                                                                                                  |          |      |            |
| Lecturers                   | Orgeira Crespo, Pedro                                                                                                                                                                                                                                                                                                                  |          |      |            |
| E-mail                      | porgeira@uvigo.es                                                                                                                                                                                                                                                                                                                      |          |      |            |
| Web                         | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                   |          |      |            |
| General description         | Real time systems in aerospace are introduced, explaining the requirements of real time systems for aerospace vehicles.<br>English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English. |          |      |            |

| <b>Competencies</b> |                                                                                                                                                                                                                                                                                    |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                |                                                                                                                                                                                                                                                                                    |
| A2                  | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study |
| A3                  | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                     |
| A5                  | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                       |
| C24                 | Appropriate knowledge applied to engineering: systems of aircrafts and automatic systems of flight control of the aerospace vehicles.                                                                                                                                              |
| C31                 | Appropriate knowledge applied to engineering: physical phenomena of air defense systems, their qualities and their control, stability and automatic control systems.                                                                                                               |
| D11                 | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                      |

| <b>Learning outcomes</b>                                                                                                        |                               |     |     |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----|-----|
| Expected results from this subject                                                                                              | Training and Learning Results |     |     |
| Knowledge, understanding, application, analysis and synthesis of the systems in real time of control of the aerospace vehicles. | A2                            | C24 | D11 |
|                                                                                                                                 | A3                            | C31 |     |
|                                                                                                                                 | A5                            |     |     |

| <b>Contents</b>                                                                                     |
|-----------------------------------------------------------------------------------------------------|
| Topic                                                                                               |
| Reactive and real-time systems                                                                      |
| Reliability and fault tolerance                                                                     |
| Concurrent programming, synchronization and communication                                           |
| Human-machine interface                                                                             |
| Real-time systems programming: real-time operating systems and synchronous/asynchronous programming |
| Simulation and verification of real-time systems                                                    |

| <b>Planning</b>          |             |                             |             |
|--------------------------|-------------|-----------------------------|-------------|
|                          | Class hours | Hours outside the classroom | Total hours |
| Lecturing                | 31          | 60                          | 91          |
| Laboratory practical     | 12          | 12                          | 24          |
| Mentored work            | 6           | 26                          | 32          |
| Introductory activities  | 1           | 0                           | 1           |
| 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.

| <b>Methodologies</b>    |                                                                                                                                                                                                                    |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | Description                                                                                                                                                                                                        |
| Lecturing               | The professor will present in the theoretical classes the contents of the subject. The students will have basic texts of reference for the follow-up of the subject.                                               |
| Laboratory practical    | Computer tools will be used to solve problems and exercises and apply the knowledge obtained in the theoretical classes, and the students will have to solve similar exercises to acquire the necessary capacities |
| Mentored work           | Project developed by the student, and mentored by the teacher                                                                                                                                                      |
| Introductory activities | Activities aimed at contacting and gathering information about students, as well as presenting the subject.                                                                                                        |

### **Personalized assistance**

| <b>Methodologies</b>    | <b>Description</b>                                                                                                                                                                                                                                           |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Introductory activities | The professor will personally answer the doubts and queries of the students. Questions will be addressed in person, especially in the classes of problems and laboratory and tutorials, as a non-contact, by the telematic systems available for the subject |
| Lecturing               | The professor will personally answer the doubts and queries of the students. Questions will be addressed in person, especially in the classes of problems and laboratory and tutorials, as a non-contact, by the telematic systems available for the subject |
| Laboratory practical    | The professor will personally answer the doubts and queries of the students. Questions will be addressed in person, especially in the classes of problems and laboratory and tutorials, as a non-contact, by the telematic systems available for the subject |
| Mentored work           | The professor will personally answer the doubts and queries of the students. Questions will be addressed in person, especially in the classes of problems and laboratory and tutorials, as a non-contact, by the telematic systems available for the subject |

### **Assessment**

|                                | Description                                  | Qualification | Training and Learning Results |                   |
|--------------------------------|----------------------------------------------|---------------|-------------------------------|-------------------|
| Laboratory practical           | Reports on practical classes, as required    | 20            | A2<br>A3<br>A5                | C24<br>D11<br>C31 |
| Mentored work                  | Presentation and report on the mentored work | 40            | A2<br>A3<br>A5                | C24<br>D11<br>C31 |
| Objective questions examExamen |                                              | 40            | A2<br>A3<br>A5                | C24<br>D11<br>C31 |

### **Other comments on the Evaluation**

The calendar of evaluation tests officially approved by the Xunta de Centro of the EEAE is published on the website of the School (normally, at <http://aero.uvigo.es/gl/docencia/exames>)

First edition (continuous evaluation):

- For the evaluation of the continuous evaluation exam to be carried out in the "first edition of the report", the student must have attended all the practices and made all the required deliveries of laboratory practices and supervised work (in the case it exists), on the dates indicated; In addition, it will be necessary that the average grade of the deliveries exceeds 4 out of 10.

- The minimum mark to be reached in the final continuous assessment exam will be 4 out of 10 to be able to weigh the exam, supervised work (in case of taking the latter), and practicals. In the case of not reaching said qualification, the final grade will be the result of the minimum of the average grade of EC and 4.0.

- To pass the subject in continuous assessment in the first edition of the report, you must pass a weighted grade (exam, work, practice) of 5 out of 10. The exam may consist of test questions and / or short questions and / or questions developmental.

Second edition:

- Students who have not passed the subject in the first edition of the minutes will take an extraordinary exam that will have

the same format and the same requirements as the ordinary exam of the first edition of the minutes. In order to pass the subject, the weighted minimum mark between exam and practice reports will be 5 out of 10, and it is also necessary that this test exceed 4 out of 10.

As a student at the University of Vigo, the University Student Statute, approved by Royal Decree 1791/2010 of December 30, establishes in its article 12, point 2d, that the university student has the duty to "refrain from the use or cooperation in fraudulent procedures in assessment tests, in the work carried out or in official university documents". Therefore, the student is expected to have adequate ethical behavior. If unethical behavior is detected during the course (copying, plagiarism, use of unauthorized electronic devices or others), the student will be penalized with a grade of 0.0 on the written or deliverable test where such fraud is detected.

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#### **Sources of information**

##### **Basic Bibliography**

Alan Burns, Andy Wellings, **Sistemas de tiempo real y lenguajes de programación**, 3ª, Prentice Hall, 1997

Xiacong Fan, **Real-Time Embedded Systems: design principles and engineering practices**, 1ª, Newnes, 2018

Jiacung Wang, **Real-Time embedded systems**, 1ª, Wiley & Sons, 2017

##### **Complementary Bibliography**

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#### **Recommendations**

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#### **Contingency plan**

##### **Description**

The evaluation will be carried out, under normal conditions, under the indications reflected in this guide.

In the event of exceptional circumstances that impede the normal development of teaching, an online teaching will be chosen (whenever possible) via streaming (live), through the tools provided by the University of Vigo. The evaluation tests would be carried out, in this case, remotely with the tools of the University; the evaluation criteria will be maintained in non-classroom teaching, except for extraordinary reasons that totally prevent said option.

In the event that teaching is carried out in a mixed way, the evaluation criteria will be maintained as well, except for extraordinary reasons that make this option totally impossible. The evaluation tests would be carried out, in this case, remotely with the tools of the University.

In both cases, tutoring meetings will take place remotely via the tools provided by the University, in a moment subject to agreement between the teacher and the student.

Students who, in any of the three cases ("normal" teaching, 100% on-line, blended), do not attend the theory teaching sessions, do not attend 100% of the practical sessions, or do not deliver all of the the memories of practices / work in term surpassing in all a 4 over 10, will carry out a different examination both in the first edition in the second, with sections that complement the test of the students of continuous evaluation.

| IDENTIFYING DATA    |                                                                                                                                                                                                                                                                                                                                 |          |      |            |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Meteorology         |                                                                                                                                                                                                                                                                                                                                 |          |      |            |
| Subject             | Meteorology                                                                                                                                                                                                                                                                                                                     |          |      |            |
| Code                | 007G410V01905                                                                                                                                                                                                                                                                                                                   |          |      |            |
| Study programme     | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                |          |      |            |
| Descriptors         | ECTS Credits                                                                                                                                                                                                                                                                                                                    | Choose   | Year | Quadmester |
|                     | 6                                                                                                                                                                                                                                                                                                                               | Optional | 4th  | 2nd        |
| Teaching language   | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                                                                                                                                         |          |      |            |
| Department          |                                                                                                                                                                                                                                                                                                                                 |          |      |            |
| Coordinator         | de la Torre Ramos, Laura                                                                                                                                                                                                                                                                                                        |          |      |            |
| Lecturers           | Algarra Cajide, Iago<br>de la Torre Ramos, Laura<br>Ferriz Mas, Antonio                                                                                                                                                                                                                                                         |          |      |            |
| E-mail              | ltr@uvigo.es                                                                                                                                                                                                                                                                                                                    |          |      |            |
| Web                 | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                            |          |      |            |
| General description | Introduction to meteorology, the measurement of parameters, the instrumentation and its influence on the flight.<br>English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English. |          |      |            |

| Competencies |                                                                                                                                                                                                                                                                                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code         |                                                                                                                                                                                                                                                                                    |
| A2           | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study |
| A3           | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                     |
| A5           | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                       |
| C10          | Understand how the aerodynamic forces determine the dynamics of the flight and the role of the different variables therein.                                                                                                                                                        |
| D11          | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                      |

| Learning outcomes                                                                          |                               |     |     |
|--------------------------------------------------------------------------------------------|-------------------------------|-----|-----|
| Expected results from this subject                                                         | Training and Learning Results |     |     |
| Knowledge of the meteorological effects and its causes                                     | A2                            | C10 | D11 |
|                                                                                            | A3                            |     |     |
|                                                                                            | A5                            |     |     |
| Understanding of the usage and impact of meteorology on aircraft operations.               | A2                            | C10 | D11 |
|                                                                                            | A3                            |     |     |
|                                                                                            | A5                            |     |     |
| Understanding of the theoretical foundations of meteorological systems and instrumentation | A2                            |     | D11 |
|                                                                                            | A3                            |     |     |
|                                                                                            | A5                            |     |     |

| Contents                                       |                                                                                                                                                                            |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                          |                                                                                                                                                                            |
| Atmosphere and meteorology                     | The atmosphere<br>Composition and structure<br>Meteors                                                                                                                     |
| Instrumentation and meteorological information | Meteorological observations in airfields<br>Meteorological observations from aircraft<br>The meteorological radar<br>Satellites<br>Aeronautical meteorological Information |

|                                  |                                                                                                                                                                                           |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Thermodynamics                   | Sounding data<br>Isobaric and adiabatic condensation<br>Aerological diagrams<br>Temperature and humidity parameters and stability levels<br>Stability assessment<br>Effects on the flight |
| Wind                             | Introduction<br>Equation of movement<br>Horizontal flow<br>Isobaric coordinates<br>Thermal wind<br>Wind structure in the PBL<br>Effects on the flight                                     |
| Clouds microphysics              | Aerosols<br>Previous concepts<br>Warm clouds<br>Cold clouds<br>Effects on the flight                                                                                                      |
| Convection                       | Previous concepts<br>Convective storms<br>Dynamics of supercells<br>Electricity<br>Downburst<br>Mesoscale convective systems (MCS)<br>Effects on the flight                               |
| Visibility                       | Introduction<br>Factors affecting visibility<br>Fogs and strata<br>Duststorms<br>Effects on the flight                                                                                    |
| Depressions                      | Introduction<br>Tropical cyclones<br>Extratropical cyclones<br>Thermal lows<br>Effects on the flight                                                                                      |
| Meteorological prediction        | Prediction<br>Numerical weather prediction                                                                                                                                                |
| Meteorology and space operations | Fundamental characteristics<br>Launching conditions<br>Reentry conditions<br>Influence in orbit                                                                                           |

## Planning

|                            | Class hours | Hours outside the classroom | Total hours |
|----------------------------|-------------|-----------------------------|-------------|
| Lecturing                  | 25          | 15                          | 40          |
| Autonomous problem solving | 15          | 20                          | 35          |
| Practices through ICT      | 10          | 0                           | 10          |
| Objective questions exam   | 2           | 30                          | 32          |
| Presentation               | 1           | 32                          | 33          |

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

## Methodologies

|                            | Description                                                                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lecturing                  | Theoretical classes in the classroom for all the group.<br>The students will have to complete assignments that will help to fix or expand their knowledge.                          |
| Autonomous problem solving | Student will be asked to perform tasks or exercises autonomously. Part of these exercises will have to be completed out of the classroom.<br>The professor will supervise the tasks |
| Practices through ICT      | Seminars using computers.<br>Personalized follow-up of the student during the class.<br>Students will be asked to solve different exercises.                                        |

## Personalized assistance

| Methodologies | Description |
|---------------|-------------|
|---------------|-------------|

|                            |                                       |
|----------------------------|---------------------------------------|
| Lecturing                  | Assistance during class and tutorials |
| Practices through ICT      | Assistance during class and tutorials |
| Autonomous problem solving | Assistance during class and tutorials |
| <b>Tests</b>               | <b>Description</b>                    |
| Presentation               | Assistance during class and tutorials |

| <b>Assessment</b>          |                                                                                                                                          |               |                               |     |     |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|-----|-----|
|                            | Description                                                                                                                              | Qualification | Training and Learning Results |     |     |
| Autonomous problem solving | Evaluation of the student's involvement in classes. Evaluation of the student's performance in the proposed tasks or problem resolution. | 20            | A2<br>A3<br>A5                | C10 | D11 |
| Practices through ICT      | Evaluation of the student's involvement in classes                                                                                       | 5             | A2<br>A3<br>A5                | C10 | D11 |
| Objective questions exam   | Answering of short answers questions plus resolution of two or three problems                                                            | 55            | A2<br>A3<br>A5                | C10 | D11 |
| Presentation               | Oral presentation oriented to teach his/her classmates about how the meteorology can affect the aerial or space operations.              | 20            | A2<br>A3<br>A5                |     | D11 |

### Other comments on the Evaluation

#### Continuous assessment:

To pass the subject through continuous assessment, it will be compulsory to attend at least 21 hours out of the 25 face-to-face sessions corresponding to the practices in computer rooms (seminars) and deliver all the tasks proposed to be done outside the classroom (both for the theoretical and the practical part).

It will also be mandatory: i) to take the written test, ii) to make the presentation

In addition, the student will have to achieve at least half of the total grade in each of the assignments that are graded.

#### In the event that a student cannot apply to continuous evaluation (for justified reasons):

The oral presentation and the delivery of the exercises proposed in seminars are compulsory, in addition to taking the written test. In addition, the student will have to achieve at least half of the total grade in each of one.

In this case the qualification percentages will be:

20% exercises proposed in seminars

10% Presentation

70% Written test

#### Second opportunity:

100% exam.

In case of not attending the test, or not passing it, the student will be evaluated in the same way as the rest of the students for the following calls.

#### End of degree call

The student who chooses to take the exam at the end of the degree will be evaluated only with the exam (which will be worth 100% of the grade). In case of not attending this exam, or not passing it, it will be evaluated in the same way as the rest of the students for the following calls.

#### Exam dates:

The exam dates are published on the website <http://aero.uvigo.es/gl/docencia/exames>

### Sources of information

#### Basic Bibliography

J. V. Iribarne, W. L. Godson, **Termodinámica de la atmósfera**, Ministerio de Medioambiente, 1996

Wallace, J.M. Y Hobbs, P, **Atmospheric Science**, Elsevier, 2006

<http://www.aemet.es/es/portada>,

[www.meted.ucar.edu/index.php](http://www.meted.ucar.edu/index.php),

#### **Complementary Bibliography**

Bohren, C. y Albrecht, B., **Atmospheric Thermodynamics**, Oxford University Press, 1998

Houze, R.A, **Cloud Dynamics**, Academic Press, 1993

[www.zamg.ac.at/docu/Manual/SatManu/main.htm](http://www.zamg.ac.at/docu/Manual/SatManu/main.htm),

### **Recommendations**

### **Contingency plan**

#### **Description**

1. MIXED MODALITY: part of the classes will be face-to-face and, if the number of students makes it necessary, another part will be through the Remote Campus

1.1. ADAPTATION OF THE METHODOLOGIES:

1.1.1.MASTER SESSION: part of the classes will be face-to-face and, if the number of students makes it necessary, another part will be through the Remote Campus

1.1.2.SEMINARS: part of the classes will be face-to-face and, if the number of students makes it necessary, another part will be through the Remote Campus

1.2. EVALUATION:

1.2.1.END OF CAREER: the test will represent 100% of the grade.

1.2.2.FIRST OPPORTUNITY: the percentage of involvement in face-to-face classes will be changed for involvement in face-to-face or virtual classes.

1.2.3.SECOND OPPORTUNITY: the test will represent 100% of the grade.

1.3. TUTORIALS: The tutorials will be in the professor's virtual office, by appointment

2. DISTANCE MODALITY: all the classes will be through the Remote Campus

2.1. ADAPTATION OF THE METHODOLOGIES:

2.1.1.MASTER SESSION: all the classes will be through the Remote Campus

2.1.2.SEMINARS: all the classes will be through the Remote Campus

2.2. EVALUATION:

2.2.1.END OF CAREER: the examination will suppose 100% of the note.

2.2.2.FIRST OPPORTUNITY: the percentage of involvement in face-to-face classes will be changed for involvement in virtual classes. The "Autonomous problem solving" will represent 10% of the grade whereas the "Objective questions exam " will represent 65% of the grade

2.2.3.SECOND OPPORTUNITY: the examination will represent 100% of the grade.

2.3. TUTORIALS: TUTORIALS: The tutorials will be in the professor's virtual office, by appointment

| IDENTIFYING DATA                   |                                                                                                                           |          |      |            |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Sistemas da xestión da información |                                                                                                                           |          |      |            |
| Subject                            | Sistemas da xestión da información                                                                                        |          |      |            |
| Code                               | 007G410V01910                                                                                                             |          |      |            |
| Study programme                    | Grao en Enxeñaría Aeroespacial                                                                                            |          |      |            |
| Descriptors                        | ECTS Credits                                                                                                              | Choose   | Year | Quadmester |
|                                    | 6                                                                                                                         | Optional | 4    | 2c         |
| Teaching language                  | Castelán Galego                                                                                                           |          |      |            |
| Department                         | Informática                                                                                                               |          |      |            |
| Coordinator                        | Celard Pérez, Pedro                                                                                                       |          |      |            |
| Lecturers                          | Celard Pérez, Pedro                                                                                                       |          |      |            |
| E-mail                             | pedrocelard@gmail.com                                                                                                     |          |      |            |
| Web                                | http://aero.uvigo.es                                                                                                      |          |      |            |
| General description                | Introdución aos sistemas de información nas empresas con aspectos respecto á súa seguridade e ferramentas da súa xestión. |          |      |            |

### Competencias

|      |                                                                                                                                                                                                                                                                      |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                      |
| A2   | Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo |
| A3   | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                  |
| A5   | Que os estudantes desenvolven aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                            |
| C24  | Coñecemento adecuado e aplicado á Enxeñaría de: Os sistemas das aeronaves e os sistemas automáticos de control de voo dos vehículos aeroespaciais.                                                                                                                   |
| D5   | Capacidade de resolución de problemas e toma de decisións                                                                                                                                                                                                            |
| D11  | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                    |

### Resultados de aprendizaxe

| Expected results from this subject                                                                                          | Training and Learning Results |     |     |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----|-----|
| RA1: Comprensión, aplicación e análise dos sistemas de xestión da información en proxectos aeroespaciais.                   | A2<br>A3<br>A5                | C24 | D11 |
| RA2: Manexar ferramentas informáticas apropiadas para o desenvolvemento profesional no ámbito do tratamento de información. | A2<br>A3                      |     | D5  |

### Contidos

|                         |                                                                                                    |
|-------------------------|----------------------------------------------------------------------------------------------------|
| Topic                   |                                                                                                    |
| Información             | - Codificación<br>- Almacenamento<br>- Procesamento<br>- Uso                                       |
| Sistemas de Información | - Recursos informáticos<br>- Ferramentas<br>- Transmisión de información<br>- Análise              |
| Seguridade              | - Ameazas e Contramedidas<br>- Ciberseguridade<br>- Protección de datos                            |
| Xestión                 | - Normas e Certificación<br>- Estándares<br>- Interoperabilidade<br>- Interfaces entre aplicacións |

### Planificación

|                   | Class hours | Hours outside the classroom | Total hours |
|-------------------|-------------|-----------------------------|-------------|
| Lección maxistral | 18          | 36                          | 54          |

|                                         |     |     |     |
|-----------------------------------------|-----|-----|-----|
| Estudo de casos                         | 20  | 30  | 50  |
| Resolución de problemas                 | 10  | 20  | 30  |
| Actividades introductorias              | 1   | 1.5 | 2.5 |
| Exame de preguntas de desenvolvemento   | 2.5 | 5   | 7.5 |
| Resolución de problemas e/ou exercicios | 1   | 5   | 6   |

\*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 profesorado dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio ou proxecto a desenvolver polo/a estudante.                                                        |
| Estudo de casos            | Análise dun feito, problema ou suceso real coa finalidade de coñecelo, interpretalo, resolvelo, xerar hipóteses, contrastar datos, reflexionar, completar coñecementos, diagnosticarlo e adestrarse en procedementos alternativos de solución. |
| Resolución de problemas    | Resolver problemas e/ou exercicios relacionados coa materia. O/a estudante debe desenvolver unha solución acertada ou correcta e interpretar os resultados.                                                                                    |
| Actividades introductorias | Actividades encamiñadas a organizar a materia, reunir fontes de información, así como a presentación do contido e planificación temporal.                                                                                                      |

### Atención personalizada

| Methodologies           | Description                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resolución de problemas | As titorías realizaranse, preferentemente, por medios telemáticos: correo electrónico ou a través do despacho persoal do profesorado no campus remoto da universidade, dentro do horario de titorías do profesorado (publicado na páxina web do centro). Será necesario contactar previamente co profesorado por correo electrónico para fixar a hora da titoría. |

### Avaliación

|                                         | Description                                                                                                                                                                                                                                                                                                         | Qualification | Training and Learning Results |     |           |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|-----|-----------|
| Estudo de casos                         | Proba na que o alumno/a debe analizar un feito, problema ou suceso real coa finalidade de coñecelo, interpretalo, resolvelo, xerar hipótese, contrastar datos, reflexionar, completar coñecementos, diagnosticarlo e adestrarse en procedementos alternativos de solución. Resultados de aprendizaxe avaliados: RA1 | 10            | A2<br>A3<br>A5                | C24 | D11       |
| Exame de preguntas de desenvolvemento   | Probas parciais que inclúen preguntas abertas sobre o contido da materia. Os alumnos/as deben desenvolver, relacionar, organizar e presentar os coñecementos que teñen sobre a materia nunha resposta argumentada. Resultados de aprendizaxe avaliados: RA1, RA2                                                    | 60            | A2<br>A3<br>A5                | C24 | D5<br>D11 |
| Resolución de problemas e/ou exercicios | Entregas periódicas individuais ou en grupo indicadas polo/o profesor/a que servirán de información sobre a marcha do/a estudante e serán ademais indicadoras da súa asistencia. Resultados de aprendizaxe avaliados: RA1, RA2                                                                                      | 30            | A2<br>A3<br>A5                | C24 | D5<br>D11 |

### Other comments on the Evaluation

#### Observacións xerais:

O alumno poderá elixir o sistema de avaliación que lle será aplicado na materia. Para iso debe optar, nos primeiros 15 días do cuadrimestre, entre avaliación continua ou avaliación final (un único exame ao final do cuadrimestre). En caso de non especificar o tipo de avaliación desexado enténdese que opta por avaliación continua.

As datas e horarios das probas de avaliación das diferentes convocatorias son as especificadas no calendario de probas de avaliación aprobado pola Xunta de Facultade para o curso 2020-21.

#### Criterios xerais de avaliación:

Para superar a materia o alumno debe obter, como nota final, unha cualificación igual ou superior a 5. Si nalgún dos bloques o alumno obtén unha nota inferior a 4, aínda que a nota media sexa igual ou superior a 5, a materia estará suspensa e a cualificación final que figurará en acta será Suspenso (4).

#### Criterios de avaliación para asistentes 1ª edición de actas:

Todos os alumnos que opten pola modalidade de avaliación continua serán avaliados de maneira continua mediante a realización de probas e actividades, desenvolvidas ao longo do cuadrimestre, aplicando os criterios xerais de avaliación

descritos no apartado anterior.

#### Criterios de avaliación para non asistentes 1ª edición de actas:

Todos os alumnos que opten pola modalidade de non asistentes serán avaliados cun exame final único (100% da nota) que englobará todo o visto ao longo do cuadrimestre, aplicando os criterios xerais de avaliación descritos anteriormente.

#### Criterios de avaliación para 2ª edición de actas e fin de carreira:

Na segunda oportunidade (Xullo) e na convocatoria de fin de carreira os estudantes serán avaliados cun exame final único (100% da nota) que englobará todo o visto ao longo do cuadrimestre, aplicando os criterios xerais de avaliación descritos anteriormente, mantendo, se procede, as cualificacións obtidas para a resolución de problemas, estudo de casos, e/ou exercicios e a asistencia e participación.

Competencias avaliadas: as mesmas que no sistema de avaliación para asistentes. Resultados de aprendizaxe avaliados: os mesmos que no sistema de avaliación para asistentes.

---

### **Bibliografía. Fontes de información**

#### **Basic Bibliography**

Connolly, T.M.; Begg, C., **Sistemas de bases de datos: un enfoque práctico para diseño, implementación y gestión**, 4, Pearson Educación, 2005

Elena Ruiz Larrocha, **Nuevas tendencias en los sistemas de información**, Editorial Universitaria Ramón Areces, 2017

#### **Complementary Bibliography**

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### **Recomendacións**

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### **Plan de Continxencias**

#### **Description**

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===

Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===

\* Metodoloxías docentes que se manteñen

- Todas

\*Metodoloxías docentes que se modifican

- As tutorías pasarán a ser online, utilizando Campus Remoto.

- As clases presenciais impartiranse a través de Campus Remoto e \*Faitic, sen prexuízo doutras contornas e mecanismos que se poidan utilizar para garantir o máximo acceso do alumnado aos contidos e materiais da materia.

\* Mecanismo non presencial de atención ao alumnado (\*tutorías). Atenderanse as tutorías do alumnado de calquera modalidade a través dos seguintes mecanismos:

- Campus Remoto

- Foros da materia en Moodle

- Correo electrónico

En todos os casos, poderase habilitar un mecanismo de concertación previa para ordenar o acceso ás tutorías.

\* Modificacións (si proceden) dos contidos a impartir

- Ningún

\* Bibliografía adicional para facilitar o auto-aprendizaxe

- Non se contempla

- \* Outras modificacións
- Non se contemplan

=== ADAPTACIÓN DA AVALIACIÓN ===

- \* Probas xa realizadas
- Mantense o peso na cualificación final

- \* Probas pendentes que se manteñen
- Mantense o peso na cualificación final

- \* Probas que se modifican
- Probas de preguntas de desenvolvemento => realizaríanse online, utilizando Campus Remoto e Faitic.

- \* Novas probas
- Non se contemplan.

- \* Información adicional
  - Non se contempla.
-

| IDENTIFYING DATA                                       |                                                                                                                                                                                          |          |      |            |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Tecnoloxías para conformado de materiais aeroespaciais |                                                                                                                                                                                          |          |      |            |
| Subject                                                | Tecnoloxías para conformado de materiais aeroespaciais                                                                                                                                   |          |      |            |
| Code                                                   | O07G410V01913                                                                                                                                                                            |          |      |            |
| Study programme                                        | Grao en Enxeñaría Aeroespacial                                                                                                                                                           |          |      |            |
| Descriptors                                            | ECTS Credits                                                                                                                                                                             | Choose   | Year | Quadmester |
|                                                        | 6                                                                                                                                                                                        | Optional | 4    | 2c         |
| Teaching language                                      | Castelán                                                                                                                                                                                 |          |      |            |
| Department                                             | Deseño na enxeñaría                                                                                                                                                                      |          |      |            |
| Coordinator                                            | Carou Porto, Diego                                                                                                                                                                       |          |      |            |
| Lecturers                                              | Carou Porto, Diego                                                                                                                                                                       |          |      |            |
| E-mail                                                 | diecapor@uvigo.es                                                                                                                                                                        |          |      |            |
| Web                                                    | http://aero.uvigo.es                                                                                                                                                                     |          |      |            |
| General description                                    | Esta materia presenta unha introdución á enxeñaría e a industrialización do produto cun enfoque práctico e moderno á fabricación de compoñentes aeroespaciais e a enxeñaría de procesos. |          |      |            |

### Competencias

|      |                                                                                                                                                                                                                                                                                                                |  |  |  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| Code |                                                                                                                                                                                                                                                                                                                |  |  |  |
| A2   | Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo                                           |  |  |  |
| A3   | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                                                            |  |  |  |
| A5   | Que os estudantes desenvolven aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                                                                      |  |  |  |
| C12  | Comprender os procesos de fabricación.                                                                                                                                                                                                                                                                         |  |  |  |
| C19  | Coñecemento aplicado de: a ciencia e tecnoloxía dos materiais; mecánica e termodinámica; mecánica de fluídos; aerodinámica e mecánica do voo; sistemas de navegación e circulación aérea; tecnoloxía aeroespacial; teoría de estruturas; transporte aéreo; economía e produción; proxectos; impacto ambiental. |  |  |  |
| C30  | Coñecemento adecuado e aplicado á Enxeñaría de: As prestacións tecnolóxicas, as técnicas de optimización dos materiais utilizados no sector aeroespacial e os procesos de tratamentos para modificar as súas propiedades mecánicas.                                                                            |  |  |  |
| D11  | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                                                              |  |  |  |

### Resultados de aprendizaxe

| Expected results from this subject                                                                                                                                                                                                                  | Training and Learning Results |                   |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------|-----|
| O/a estudante coñece os procesos de produción, os seus principais parámetros definitorios e o seu campo de aplicación.                                                                                                                              | A2<br>A3<br>A5                | C12<br>C19<br>C30 | D11 |
| O/a estudante coñece toda a información necesaria para levar a cabo un proceso de produción.                                                                                                                                                        | A2<br>A3<br>A5                | C12<br>C19<br>C30 | D11 |
| O/a estudante é capaz de realizar un informe que permita a execución exitosa dun proceso de produción.                                                                                                                                              | A2<br>A3<br>A5                | C12<br>C19<br>C30 | D11 |
| Coñecer adecuadamente e de forma aplicada á enxeñaría as prestacións tecnolóxicas, as técnicas de optimización dos procesos de fabricación con materiais utilizados no sector aeroespacial para modificar as súas propiedades funcionais mecánicas. | A2<br>A3<br>A5                | C12<br>C19<br>C30 | D11 |

### Contidos

|       |  |
|-------|--|
| Topic |  |
|-------|--|

## Bloque I

1. Deseño de produto
2. Elaboración de prototipos. Fabricación aditiva
3. Conformado de polímeros e materiais compostos. Simulación
4. Conformado por eliminación de material
5. Conformado mediante métodos non convencionais
6. Aplicación de ferramentas CAM na simulación do proceso de mecanizado
7. Automatización. Industria 4.0 no sector aeroespacial
8. Monitorización de procesos
9. Calidade industrial

## Bloque II

## Proxectos

### Planificación

|                                  | Class hours | Hours outside the classroom | Total hours |
|----------------------------------|-------------|-----------------------------|-------------|
| Lección maxistral                | 18          | 9                           | 27          |
| Prácticas con apoio das TIC      | 8           | 16                          | 24          |
| Aprendizaxe colaborativa         | 1           | 2                           | 3           |
| Aprendizaxe baseado en proxectos | 23          | 73                          | 96          |

\*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.                                                                                                                                                                                                       |
| 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, os estudantes poderán resolver problemas específicos que permitan mellorar o seu coñecemento sobre os procesos estudados. |
| Aprendizaxe colaborativa         | O profesor exporá temas de estudo que os estudantes traballarán de maneira autónoma para elaborar contidos adicionais de maneira colaborativa.                                                                                                                               |
| Aprendizaxe baseado en proxectos | O obxectivo prioritario deste curso será a aprendizaxe adquirida mediante o deseño e desenvolvemento de produto/proceso, que se realizará en función dos medios dispoñibles, aplicando contidos, técnicas e resolución de problemas, adquiridos en teoría e práctica         |

### Atención personalizada

| Methodologies                    | Description                                                                    |
|----------------------------------|--------------------------------------------------------------------------------|
| Lección maxistral                | Prestarase atención ao alumnado tanto no horario lectivo como no de *tutorías. |
| Aprendizaxe baseado en proxectos | Prestarase atención ao alumnado tanto no horario lectivo como no de *tutorías. |
| Prácticas con apoio das TIC      | Prestarase atención ao alumnado tanto no horario lectivo como no de *tutorías. |
| Aprendizaxe colaborativa         | Prestarase atención ao alumnado tanto no horario lectivo como no de *tutorías. |

### Avaliación

|                                  | Description                            | Qualification | Training and Learning Results |                   |     |
|----------------------------------|----------------------------------------|---------------|-------------------------------|-------------------|-----|
| Prácticas con apoio das TIC      | Entrega de memorias de prácticas       | 15            | A2<br>A3<br>A5                | C12<br>C19<br>C30 | D11 |
| Aprendizaxe colaborativa         | Participación en actividades propostas | 5             | A2<br>A3<br>A5                | C12               |     |
| Aprendizaxe baseado en proxectos | Entrega memoria de proxecto            | 80            | A2<br>A3<br>A5                | C12<br>C19<br>C30 | D11 |

### Other comments on the Evaluation

PRIMEIRA EDICIÓN DE ACTA:

A materia avalíase en base a:

-Traballo da materia (nota máxima 8 puntos).

-Prácticas (nota máxima 1,5 puntos). Entrega obrigatoria de memorias de prácticas nas datas estipuladas.

-Aprendizaxe colaborativo (nota máxima 0,5 puntos). Deberase participar nas actividades propostas durante o curso.

Aprobarán a materia aqueles estudantes que consigan unha nota igual ou superior a 5 puntos.

## SEGUNDA e SUCEVAS EDICIÓNS DE ACTA:

O método de avaliación é o mesmo que o descrito para a PRIMEIRA EDICIÓN DE ACTA.

## OUTRAS CONSIDERACIÓNS:

Os estudantes non-asistentes serán avaliados cun exame final que cobre 100% das competencias da materia.

Os traballos serán entregados o día do exame da materia.

En caso de discrepancia entre o contido da Guía Docente nas súas versións en Castelán, Galego e Inglés, prevalecerá o establecido na versión en Castelán.

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>

## Bibliografía. Fontes de información

### Basic Bibliography

Mikell P. Groover, **Fundamentos de manufactura moderna : materiales, procesos y sistemas**, 3, Prentice-Hall, 2007

S. Kalpakjian, S.R. Schmid, **Manufactura, Ingeniería y Tecnología**, 7, Pearson Education, 2014

### Complementary Bibliography

T. Black, R. Kohser, **Degarmo's Materials and Processes in Manufacturing**, 12, Wiley, 2017

John G. Nee, **Fundamentals of Tool Design**, 6, SME, 2010

Sham Tickoo, **Catia v5-6 R2014 for designers**, 12, Shererville IN: CAD/CIM Technologies, 2015

Egberto Garijo Gómez, **Diseño y fabricación con CATIA v5 : módulos CAM : mecanización por arranque de viruta**, 1, Visión Libros,, 2012

D. Carou, J.P. Davim, **Machining of Light Alloys Aluminum, Titanium, and Magnesium**, 1, CRC Press, 2019

## Recomendacións

## Subjects that it is recommended to have taken before

Fabricación aeroespacial/O07G410V01501

## Plan de Continxencias

### Description

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===

Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo \*COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

=== ADAPTACIÓN DAS METODOLOXÍAS ===

\* Metodoloxías docentes que se manteñen

Todas se manteñen en formato asíncrono ou síncrono a distancia. Para iso empregaranse os medios dispostos pola Universidade de Vigo: Campus Remoto e/ou FAITIC.

\* Metodoloxías docentes que se modifican

\* Mecanismo non presencial de atención ao alumnado (\*tutorías)

Desenvolveranse mediante \*email ou videoconferencia en despacho virtual.

\* Modificacións (si proceden) dos contidos a impartir

\* Bibliografía adicional para facilitar o auto-aprendizaxe

\* Outras modificacións

=== ADAPTACIÓN DA AVALIACIÓN ===

\* Probas xa realizadas

Proba \*XX: [Peso anterior 00%] [Peso Proposto 00%]

...

\* Probas pendentes que se manteñen

Proba \*XX: [Peso anterior 00%] [Peso Proposto 00%]

...

\* Probas que se modifican

[Proba anterior] = > [Proba nova]

\* Novas probas

\* Información adicional

A avaliación mantense sen cambios en calquera circunstancia.

No escenario multimodal e/ou non presencial, cando cumpra, o persoal docente implicado na impartición da docencia resérvase o dereito de non dar o consentimento para a captación, publicación, retransmisión ou reprodución do seu discurso, imaxe, voz e explicacións de cátedra, no exercicio das súas funcións docentes, no ámbito da Universidade de Vigo.

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| <b>IDENTIFYING DATA</b>    |                                                                                                                                                                                                                                                                                                                                                                                                                                |          |      |            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| <b>Mechanics of flight</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                |          |      |            |
| Subject                    | Mechanics of flight                                                                                                                                                                                                                                                                                                                                                                                                            |          |      |            |
| Code                       | 007G410V01924                                                                                                                                                                                                                                                                                                                                                                                                                  |          |      |            |
| Study programme            | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                               |          |      |            |
| Descriptors                | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                   | Choose   | Year | Quadmester |
|                            | 6                                                                                                                                                                                                                                                                                                                                                                                                                              | Optional | 4th  | 1st        |
| Teaching language          | #EnglishFriendly<br>Spanish                                                                                                                                                                                                                                                                                                                                                                                                    |          |      |            |
| Department                 |                                                                                                                                                                                                                                                                                                                                                                                                                                |          |      |            |
| Coordinator                | Navarro Medina, Fermín                                                                                                                                                                                                                                                                                                                                                                                                         |          |      |            |
| Lecturers                  | Navarro Medina, Fermín                                                                                                                                                                                                                                                                                                                                                                                                         |          |      |            |
| E-mail                     | fermin.navarro.medina@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                 |          |      |            |
| Web                        | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                           |          |      |            |
| General description        | Flight mechanics include the study of the performance, stability, and static and dynamic control of aerospace vehicles (focusing on fixed-wing aircraft in this course), as well as flight qualities and tests.<br>English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English. |          |      |            |

### Competencies

|      |                                                                                                                                                                                                                                                                                    |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                    |
| A2   | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study |
| A3   | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                     |
| A5   | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                       |
| B6   | Capability to participate in flight testing programs for take-off and landing distances, ascent speeds, loss speeds, maneuverability and landing capacities.                                                                                                                       |
| C23  | Appropriate knowledge applied to engineering: physical phenomena of flight, its qualities and its control, aerodynamics, propulsive forces, active control and stability.                                                                                                          |
| C26  | Applied knowledge of aerodynamics; mechanics and thermodynamics, flight mechanics, aircraft engineering (fixed and rotary wings), theory of structures.                                                                                                                            |
| C31  | Appropriate knowledge applied to engineering: physical phenomena of air defense systems, their qualities and their control, stability and automatic control systems.                                                                                                               |
| C33  | Applied knowledge of aerodynamics, flight mechanics, air defense engineering (ballistics, missiles and air systems), space propulsion, material science and technology, structure theory.                                                                                          |
| D3   | Capability of oral and written communication in native language                                                                                                                                                                                                                    |
| D4   | Capability of autonomous learning and information management                                                                                                                                                                                                                       |
| D5   | Capability to solve problems and draw decisions                                                                                                                                                                                                                                    |
| D6   | Capability for interpersonal communication                                                                                                                                                                                                                                         |
| D8   | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                |
| D11  | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                      |

### Learning outcomes

| Expected results from this subject                                                                                                               | Training and Learning Results |    |            |                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|------------|----------------------|
| Knowledge of the most stood out appearances of the qualities of flight and the essays in flight of the aircraft                                  | A5                            | B6 | C23<br>C33 | D8<br>D11            |
| Knowledge, understanding, application, analysis and synthesis of the performances, the stability and control static and dynamic of the aircraft. | A2<br>A3                      |    | C26<br>C31 | D3<br>D4<br>D5<br>D6 |

### Contents

| Topic                                       |                                                                                                                                                          |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Introduction to the mechanics of flight. | 1.1. Introduction to the mechanics of flight.<br>1.2. Systems of reference and angles in mechanics of flight.<br>1.3. General equations of the movement. |

|                                                                                                     |                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2. Performances of gliders and aeroplanes propulsados by aerorreactores and by alternative engines. | 2.1. Performances of gliders<br>2.2. Performances of aeroplanes propulsados by aerorreactores in horizontal rectilinear flight<br>2.3. Performances of aeroplanes propulsados by aerorreactores in another type of flights<br>2.4. Performances of aeroplanes propulsados by alternative engines<br>2.5. Performances in takeoff and landing |
| 3. Stability and static and dynamic control                                                         | 3.1. Stability and longitudinal static control<br>3.2. Stability and lateral static control-directional<br>3.3. Introduction to the stability and dynamic control                                                                                                                                                                            |
| 4. Introduction to the Qualities of Flight and to the Essays in Flight.                             | 4.1. Introduction to the Qualities of Flight and to the Essays in Flight.                                                                                                                                                                                                                                                                    |

## Planning

|                                 | Class hours | Hours outside the classroom | Total hours |
|---------------------------------|-------------|-----------------------------|-------------|
| Problem solving                 | 15          | 0                           | 15          |
| Lecturing                       | 28          | 0                           | 28          |
| Autonomous problem solving      | 0           | 97.5                        | 97.5        |
| Mentored work                   | 4           | 0                           | 4           |
| Problem and/or exercise solving | 3           | 0                           | 3           |
| Objective 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                                                                                                                                                                                                                                                                                             |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Problem solving            | Resolution of problems and/or exercises that treat punctual appearances of the contents of the subject, developed by the professor and/or the students in the classroom.                                                                                                                                |
| Lecturing                  | Exhibition of a subject by part of the professor according to a previously established script                                                                                                                                                                                                           |
| Autonomous problem solving | Study of the student of autonomous form, with the support of the professor if like this it requires it according to the procedures established by the university                                                                                                                                        |
| Mentored work              | The work tutelado consists in the preparation of a project of design of an aircraft using the concepts learnt during the subject of mechanics of flight. It will be necessary on the other hand review key ideas of the subject of aerodynamics and aeroelasticidad. The work is of preparation grupal. |

## Personalized assistance

| Methodologies              | Description                                                                                                                                                                                                                                                                                             |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mentored work              | The work tutelado consists in the preparation of a project of design of an aircraft using the concepts learnt during the subject of mechanics of flight. It will be necessary on the other hand review key ideas of the subject of aerodynamics and aeroelasticidad. The work is of preparation grupal. |
| Autonomous problem solving | Study of the student of autonomous form, with the support of the professor if like this it requires it according to the procedures established by the university                                                                                                                                        |

## Assessment

|                                 | Description                                                                                                                                                                                                                                                                                             | Qualification | Training and Learning Results |    |                          |                                   |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|--------------------------|-----------------------------------|
| Mentored work                   | The work tutelado consists in the preparation of a project of design of an aircraft using the concepts learnt during the subject of mechanics of flight. It will be necessary on the other hand review key ideas of the subject of aerodynamics and aeroelasticidad. The work is of preparation grupal. | 25            | A2<br>A3<br>A5                | B6 | C23<br>C26<br>C31<br>C33 | D4<br>D5<br>D6<br>D8<br>D11       |
| Problem and/or exercise solving | Approach of problems to study and resolve in the classroom on the contents of the subject, to make by the student individually and/or in group                                                                                                                                                          | 15            | A2<br>A3<br>A5                | B6 | C23<br>C26<br>C31<br>C33 | D3<br>D4<br>D5<br>D6<br>D8<br>D11 |
| Objective questions exam        | Resolution of problems and/or conceptual questions on the contents of the subject                                                                                                                                                                                                                       | 60            | A2<br>A3<br>A5                | B6 | C23<br>C26<br>C31<br>C33 | D3<br>D4<br>D5<br>D8<br>D11       |

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## Other comments on the Evaluation

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### Continuous assessment

To surpass the subject in the first assessment is required to obtain a mark upper to 5 points on 10 in the average mark of the continuous assessment during the development of the classes and the examination in the official date. The mark of the examination in official date has to be upper to 5 points on 10. The final mark will be calculated according to the percentages indicated. The scored activities of the continuous assessment will take place during the lecturing hours of the subject, so that it requires the regular attendance to the classes by part of the students.

The calendar of proofs of assessment approved officially by the Board of Centre EEAE is published in the web

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

The maximum duration of the examination will be 3 hours if there is not interruption, or of 5 hours if there is an intermediate pause (being a maximum of 3 hours for each part).

### Extraordinary examination

The student has to attend to the extraordinary examination of all the contents of the subject, that will be 100% of the mark, if the final mark of continuous assessment is lower that 5 points on 10. Besides, they have to attend the extraordinary examination in the following cases:

- They did not make or deliver any of the scored activities of the continuous assessment inside the terms and dates established.
- They obtained an mark lower than 5 points over 10 in the final examination of continuous assessment .

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## Sources of information

### Basic Bibliography

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

### Complementary Bibliography

PHILLIPS W., **Mechanics of Flight**, 2, John Wiley & Sons Ltd, 2009

Hull D.G., **Fundamentals of Airplane Flight Mechanics**, 1, Springer, 2007

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## Recommendations

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### Subjects that it is recommended to have taken before

Aerodynamics and aeroelasticity/O07G410V01923

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## Contingency plan

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### Description

=== EXCEPTIONAL MEASURES SCHEDULED ===

In front of the uncertain and unpredictable evolution of the sanitary alert caused by the \*COVID-19, the University of Vigo establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or partially face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a more agile and effective way when being known in advance (or with a wide \*antelación) by the students and the professor through the tool normalised and institutionalised of the educational guides.

=== ADAPTATION OF THE METHODOLOGIES ===

\* educational Methodologies that keep

ALL, adapted to the available technological resources (remote campus, virtual blackboard, etc). The work \*tutelado also can carry out on-line, without more than substituting the meetings \*grupales and the sessions \*tutorizadas with the the face-to-face professor by telematic.

\* Educational methodologies that modify  
ANY

\* no face-to-face Mechanism of attention to the students (\*tutorías)  
virtual Dispatch of the remote campus

\* Modifications (if they proceed) of the contents to give ANY

\* additional Bibliography to facilitate the car-learning  
Can use the same \*bibliografía

\* Other modifications

### === ADAPTATION OF THE EVALUATION ===

In the case that the teaching have to give to distance from some moment of the \*cuatrimestre, distinguish two cases:

\*\*\* That all the proofs \*evaluables already have been made in the moment of the change to teaching to distance:

- it Tests Examination of objective questions: 60%
- it Tests Work \*tutelado: 25%
- it Tests Resolution of problems and/or exercises: 15%

\*\*\* That there are pending proofs to make:

\* Proofs \*evaluables slopes to make in the moment of change to teaching to distance, that keep his percentages of evaluation:

- it Tests Examination of objective questions: [previous Weight 60%] [Weight Proposed 60%]
- Tests Work \*tutelado: [previous Weight 25%] [Weight Proposed 25%]

\* Proofs \*evaluables slopes to make in the moment of change to teaching to distance, that modify mildly:

- it Tests Resolution of problems and/or exercises: [previous Weight 15%] [Weight Proposed 15%]. In case of impossibility to make them in the classroom, the problems will deliver in shape of bulletin to deliver, with a date established in the moment of the delivery.

\* New proofs  
NO new exams

\* additional Information

will inform of the links and the keys to access to the virtual classroom and to the virtual dispatch. The tutoring sessions will make in the virtual dispatch, after previous agreement of the date and hour via mail.

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| IDENTIFYING DATA                       |                                                                                                                        |          |      |            |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| <b>Aeronaves de á fixa e rotatoria</b> |                                                                                                                        |          |      |            |
| Subject                                | Aeronaves de á fixa e rotatoria                                                                                        |          |      |            |
| Code                                   | 007G410V01934                                                                                                          |          |      |            |
| Study programme                        | Grao en Enxeñaría Aeroespacial                                                                                         |          |      |            |
| Descriptors                            | ECTS Credits                                                                                                           | Choose   | Year | Quadmester |
|                                        | 9                                                                                                                      | Optional | 4    | 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://aero.uvigo.es                                                                                                   |          |      |            |
| General description                    | Deseño de aeronaves de á fixa e rotatoria, coas súas tipoloxías, métodos de cálculo, estabilidade, control e sistemas. |          |      |            |

| Competencias |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code         |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| A2           | Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo                                                                                                                                                                                      |
| A3           | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                                                                                                                                                                                                       |
| A5           | Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                                                                                                                                                                                                               |
| C24          | Coñecemento adecuado e aplicado á Enxeñaría de: Os sistemas das aeronaves e os sistemas automáticos de control de voo dos vehículos aeroespaciais.                                                                                                                                                                                                                                                                                                        |
| C25          | Coñecemento adecuado e aplicado á Enxeñaría de: os métodos de cálculo de deseño e proxecto aeronáutico; o uso da experimentación aerodinámica e dos parámetros máis significativos na aplicación teórica; o manexo das técnicas experimentais, equipamento e instrumentos de medida propios da disciplina; a simulación, deseño, análise e interpretación de experimentación e operacións en voo; os sistemas de mantemento e certificación de aeronaves. |
| C26          | Coñecemento aplicado de: aerodinámica; mecánica e termodinámica, mecánica do voo, enxeñaría de aeronaves (á fixa e ás rotatorias), teoría de estruturas.                                                                                                                                                                                                                                                                                                  |
| D3           | Capacidade de comunicación oral e escrita na lingua nativa                                                                                                                                                                                                                                                                                                                                                                                                |
| D4           | Capacidade de aprendizaxe autónoma e xestión da información                                                                                                                                                                                                                                                                                                                                                                                               |
| D6           | Capacidade de comunicación interpersoal                                                                                                                                                                                                                                                                                                                                                                                                                   |
| D8           | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                                                                                                                                            |
| D11          | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                                                                                                                                                                                                         |

| Resultados de aprendizaxe                                                                                                                                           |    |                               |     |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-------------------------------|-----|--|
| Expected results from this subject                                                                                                                                  |    | Training and Learning Results |     |  |
| - Coñecemento aplicado dos sistemas das aeronaves                                                                                                                   | A2 | C24                           | D3  |  |
|                                                                                                                                                                     | A3 | C25                           | D4  |  |
|                                                                                                                                                                     | A5 | C26                           | D6  |  |
|                                                                                                                                                                     |    |                               | D8  |  |
|                                                                                                                                                                     |    |                               | D11 |  |
| - Coñecemento, comprensión, aplicación, da aerodinámica dos rotores, as actuacións e a estabilidade e controlabilidade das aeronaves das aeronaves de ás rotatorias | A2 | C24                           | D3  |  |
|                                                                                                                                                                     | A3 | C25                           | D6  |  |
|                                                                                                                                                                     | A5 | C26                           | D8  |  |
| - Coñecemento dos aspectos máis destacados das calidades de voo e os ensaios en voo das aeronaves de ás rotatorias                                                  | A2 | C24                           | D3  |  |
|                                                                                                                                                                     | A3 | C25                           | D4  |  |
|                                                                                                                                                                     | A5 | C26                           | D6  |  |
|                                                                                                                                                                     |    |                               | D8  |  |
|                                                                                                                                                                     |    |                               | D11 |  |

| Contidos                                        |  |
|-------------------------------------------------|--|
| Topic                                           |  |
| Tema 1. Tipos de aeronaves de á fixa            |  |
| Tema 2. Métodos de cálculo de deseño e proxecto |  |

Tema 3. Arquitectura e deseño de compoñentes (fuselaxes, ás, superficies estabilizadoras, trens de aterraxe, etc.)

Tema 4. Sistemas

Tema 5. Aerodinámica de rotores (Voo Vertical e Voo de Avance)

Tema 6. Actuacións de aeronaves de ás rotatorias

Tema 7. Introducción á estabilidade e controlabilidade das aeronaves de ás rotatorias

Tema 8. Introducción ás Calidades de Voo e aos Ensaos en Voo das aeronaves de ás rotatorias

## Planificación

|                                       | Class hours | Hours outside the classroom | Total hours |
|---------------------------------------|-------------|-----------------------------|-------------|
| Lección maxistral                     | 30          | 68                          | 98          |
| Traballo tutelado                     | 22.5        | 45                          | 67.5        |
| Prácticas de laboratorio              | 22.5        | 22.5                        | 45          |
| Seminario                             | 3.5         | 7                           | 10.5        |
| Exame de preguntas de desenvolvemento | 2           | 0                           | 2           |
| Presentación                          | 0.5         | 1.5                         | 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 por parte do profesor/a dos contidos sobre a materia obxecto de estudo, bases teóricas e/ou directrices dun traballo, exercicio que o/a estudante ten que desenvolver.                                                                                                  |
| Traballo tutelado        | 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.                                                                                |
| Prácticas de laboratorio | Actividades de aplicación dos coñecementos a situacións concretas e de adquisición de habilidades básicas e procedementais relacionadas coa materia obxecto de estudo. Desenvólvense en espazos especiais con equipamento especializado (Laboratorios, aulas informáticas, etc...) |
| Seminario                | Actividade enfocada ao traballo sobre un tema específico, que permite afondar ou complementar os contidos da materia. Pódese empregar como complemento das clases teóricas                                                                                                         |

## Atención personalizada

### Methodologies Description

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lección maxistral | No ámbito da acción tutorial, distínguense accións de tutoría académica, así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupais para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías 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 tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. |
| Traballo tutelado | No ámbito da acción tutorial, distínguense accións de tutoría académica, así como de tutoría personalizada. No primeiro dos casos, o alumnado terá á súa disposición horas de tutorías nas que pode consultar calquera dúbida relacionada cos contidos, organización e planificación da materia, co desenvolvemento do proxecto, etc. As tutorías poden ser individualizadas, pero fomentaranse tutorías grupais para a resolución de problemas relacionados coas actividades a realizar en grupo, ou simplemente para informar ao docente da evolución do traballo colaborativo. Nas tutorías 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 tutorial, preténdense compensar os diferentes ritmos de aprendizaxe mediante a atención á diversidade. |

## Avaliación

|                          | Description                         | Qualification | Training and Learning Results       |
|--------------------------|-------------------------------------|---------------|-------------------------------------|
| Prácticas de laboratorio | Memoria de prácticas de laboratorio | 15            | A2 C24 D3<br>A3 C25 D4<br>A5 C26 D8 |

|                                       |                                                                         |    |                |                   |                             |
|---------------------------------------|-------------------------------------------------------------------------|----|----------------|-------------------|-----------------------------|
| Exame de preguntas de desenvolvemento | Realización de probas parciais e dun exame final de avaliación continua | 60 | A2<br>A3<br>A5 | C24<br>C25<br>C26 | D3<br>D4                    |
| Presentación                          | Presentación en clase do traballo grupal desenvolvido.                  | 25 | A2<br>A3<br>A5 | C24<br>C25<br>C26 | D3<br>D4<br>D6<br>D8<br>D11 |

### Other comments on the Evaluation

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>

### Primeira edición de actas

#### (1) Estudiantes que seguen o curso por Avaliación Continua:

Para poder superar a materia na primeira edición de actas, mediante Avaliación Continua, será necesario:

-Unha nota, no exame final de avaliación continua, non inferior a 4.0.

-Entregar todas as prácticas e traballos da materia obtendo, como mínimo, unha nota de 3 en cada un deles.

No caso de non cumprir ditas condicións a nota final será a resultante do mínimo da nota media de EC e de 4.0.

#### (2) Estudiante que, tras unha autorización por parte do profesorado, renuncien á Avaliación Continua:

A avaliación do curso na primeira edición de acta realizarase, por defecto, mediante a Avaliación Continua.

Os estudantes que teñan unha xustificación poderán renunciar oficialmente á avaliación continua e realizar un só exame final, na data oficial. A nota obtida neste exame representará o 100% da nota final. O alumno deberá superar o 5 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

A renuncia á avaliación continua debe facerse durante o primeiro mes de clase. Durante este período, presentarse o xustificante ao coordinador da materia para a súa avaliación.

### Segunda edición de actas.

Os alumnos que non superasen a materia na primeira edición de actas poderán realizarán un exame que supoñerá o 100% da nota. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

O Estatuto do Estudiante Universitario, establece que o estudante universitario ten o deber de "absterse da utilización ou cooperación en procedementos fraudulentos nas probas de avaliación, nos traballos que se realicen ou en documentos oficiais da universidade". Por iso, espérase que o alumno teña un comportamento ético adecuado. Se se detectase un comportamento pouco ético durante o curso (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros), penalizarase ao alumno cunha nota de 0,0 na proba escrita ou entregable onde se detectase devandita fraude.

### Bibliografía. Fontes de información

#### Basic Bibliography

Daniel P. Raymer, **Aircraft Design: A conceptual approach**, 978-1-62410-490-9, 6, American Institute of Aeronautics and Astronautics, 2020

Álvaro Cuerva Tejero, **Teoría de los Helicópteros**, 978-84-935350-4-9, 2, Universidad Politécnica de Madrid, 2009

#### Complementary Bibliography

Lloyd R. Jenkinson, James F. Marchman III, **Aircraft Design Projects**, Butterworth-Heinemann, 2003

David W. Hall, P.E., **Aircraft Conceptual And Preliminary Design**, San Luis Obispo California, 2000

Darrol Stinton, **The Design Of The Airplane**, Granada Publishing,

Alejandro Roger Ull, **Diseño de helicópteros y aeronaves diversas**, Universitat Politècnica de Catalunya,

### Recomendacións

#### Subjects that it is recommended to have taken before

Aerodinámica e aeroelasticidade/O07G410V01923

### Plan de Continxencias

## Description

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### === MEDIDAS EXCEPCIONAIS PLANIFICADAS ===

Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID-19, a Universidade establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determinen, atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial.

Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dunha maneira máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado, e o profesorado, a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

#### Escenario 1: Docencia mixta

Debido á situación excepcional, #ante a imposibilidade de poder impartir a docencia dun modo totalmente presencial, utilizaranse medios virtuais tanto síncronas como asíncronas para a impartición das clases que sexan habilitadas pola Universidade de Vigo.

As prácticas serán entregadas polos estudantes e avaliadas empregando os recursos da plataforma de teledocencia dispoñible no seu momento.

As sesións de tutorización, tanto o nivel individual como o nivel de grupos poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, salgas/aulas/despachos virtuais proporcionadas pola Universidade de Vigo).

#### Escenario 2: Docencia non-presencial

Debido á situación excepcional, #ante a imposibilidade de poder impartir a docencia dun modo presencial, utilizaranse medios virtuais para a impartición das clases que sexan habilitadas pola Universidade de Vigo.

As prácticas serán entregadas polos estudantes e avaliadas empregando os recursos da plataforma de teledocencia dispoñible no seu momento.

As sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, salgas/aulas/despachos virtuais proporcionadas pola Universidade de Vigo).

### === ADAPTACIÓN DAS METODOLOXÍAS ===

As metodoloxías docentes que se manteñen principalmente cunha posible modificación temporal na planificación segundo situación concreta.

Non procede ningunha modificacións dos contidos para impartir.

Auméntase a bibliografía co material de elaboración propia (por exemplo, guías de traballo, vídeos e textos explicativos, problemas resoltos, etc.) para facilitar a auto-aprendizaxe.

### === ADAPTACIÓN DA AVALIACIÓN ===

As probas mantéñense coas súas ponderacións previstas.

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| <b>IDENTIFYING DATA</b>                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |      |            |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| <b>Maintenance and certification of aerospace vehicles</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |      |            |
| Subject                                                    | Maintenance and certification of aerospace vehicles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |      |            |
| Code                                                       | 007G410V01935                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |      |            |
| Study programme                                            | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |      |            |
| Descriptors                                                | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Choose   | Year | Quadmester |
|                                                            | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Optional | 4th  | 1st        |
| Teaching language                                          | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |      |            |
| Department                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |      |            |
| Coordinator                                                | Ulloa Sande, Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |      |            |
| Lecturers                                                  | Ulloa Sande, Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |      |            |
| E-mail                                                     | carlos.ulloa@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |      |            |
| Web                                                        | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |      |            |
| General description                                        | <p>Airworthiness is the ability of aircraft to fly. This quality is ensured through certification, which is made up of a set of tasks that guarantee that the aircraft is in safe conditions for the flight. To ensure that these conditions are maintained over time, we must speak of continuing airworthiness, that is, all the revisions, modifications and maintenance tasks necessary to maintain airworthiness over time. This subject deals with the procedures that affect airworthiness, basically analyzing the EASA and FAA regulations.</p> <p>English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.</p> |          |      |            |

### Competencies

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A2   | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study                                                                                                                                                             |
| A3   | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                                                                                                                                                                                 |
| A5   | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                                                                                                                                                                                   |
| B3   | Installation, operation and maintenance in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, aerospace propulsion systems, aerospace materials, infrastructures and airports, air navigation infrastructures and space management, air traffic and transport management systems.                                                                        |
| B4   | Verification and certification in the field of aeronautical engineering that aim, in accordance with the knowledge acquired (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, aerospace propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.                                  |
| C21  | Appropriate knowledge applied to engineering: foundations of sustainability, maintenance and operation of aerospace vehicles.                                                                                                                                                                                                                                                                                                                  |
| C25  | Appropriate knowledge applied to engineering: methods of design calculations and aeronautical projects; use of aerodynamic experimentation and the most significant parameters in the theoretical application; management of experimental techniques, equipment and measuring instruments; simulation, design, analysis and interpretation of experimentation and operations in flight; systems of maintenance and certification of aircrafts. |
| D3   | Capability of oral and written communication in native language                                                                                                                                                                                                                                                                                                                                                                                |
| D4   | Capability of autonomous learning and information management                                                                                                                                                                                                                                                                                                                                                                                   |
| D5   | Capability to solve problems and draw decisions                                                                                                                                                                                                                                                                                                                                                                                                |
| D6   | Capability for interpersonal communication                                                                                                                                                                                                                                                                                                                                                                                                     |
| D8   | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                                                                                                                                                                            |
| D11  | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                                                                                                                                                                                  |
| D13  | Sustainability and environmental commitment. Equitable, responsible and efficient use of resources                                                                                                                                                                                                                                                                                                                                             |

### Learning outcomes

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

|                                                                                                                    |                |          |     |                                          |
|--------------------------------------------------------------------------------------------------------------------|----------------|----------|-----|------------------------------------------|
| - Knowledge, understanding, application, analysis and synthesis of aircraft certification and maintenance methods. | A2<br>A3<br>A5 | B3<br>B4 | C21 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
| - Applied knowledge of simulation, design, analysis and synthesis of experimentation and flight operations.        | A2<br>A3<br>A5 | B3<br>B4 | C25 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |

## Contents

| Topic                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Block 1: Certification | Unit 1.1: Introduction and concepts<br>Unit 1.2: Organizations competent in airworthiness<br>Unit 1.3: Airworthiness requirements<br>Unit 1.4: The type certificate. The TC process.<br>Unit 1.5: Production of articles, pieces and devices.<br>Unit 1.6: Certificates of airworthiness<br>Unit 1.7: Aircraft and operations certification codes<br>Unit 1.8: Modification of aircraft<br>Unit 1.9: Testing during certification and test flights |
| Block 2: Maintenance   | Unit 2.1: Fundamentals of aeronautical maintenance<br>Unit 2.2: Continuing airworthiness<br>Unit 2.3: Management and types of maintenance<br>Unit 2.4: Quality assurance and maintenance safety                                                                                                                                                                                                                                                    |

## Planning

|                                                       | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------------------|-------------|-----------------------------|-------------|
| Lecturing                                             | 33          | 0                           | 33          |
| Laboratory practical                                  | 20          | 0                           | 20          |
| Seminars                                              | 3.5         | 0                           | 3.5         |
| Previous studies                                      | 0           | 126                         | 126         |
| Objective questions exam                              | 2.5         | 0                           | 2.5         |
| Report of practices, practicum and external practices | 0           | 10                          | 10          |
| Essay                                                 | 20          | 10                          | 30          |

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

## Methodologies

|                      | Description                                                                                                             |
|----------------------|-------------------------------------------------------------------------------------------------------------------------|
| Lecturing            | Classroom lectures                                                                                                      |
| Laboratory practical | Labs using different testing techniques<br>Conducting certification practices<br>Case studies of accident investigation |
| Seminars             | Tutoring in small groups                                                                                                |
| Previous studies     | Autonomous work                                                                                                         |

## Personalized assistance

| Methodologies | Description                                                                                                                                                           |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seminars      | Small group tutoring with the teachers of the subject. The tutorials will be held, preferably, by appointment, in the teacher's virtual office, on the Remote Campus. |

## Assessment

| Description | Qualification | Training and Learning Results |
|-------------|---------------|-------------------------------|
|-------------|---------------|-------------------------------|

|                                                       |                                                                                                                     |    |                |          |            |                                          |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----|----------------|----------|------------|------------------------------------------|
| Objective questions exam                              | Partial eliminatory exam and problems (40%)*                                                                        | 80 | A2<br>A3<br>A5 | B3<br>B4 | C21<br>C25 | D3<br>D4<br>D5<br>D8<br>D11<br>D13       |
|                                                       | Final exam Maintenance of short questions and problems (40%)                                                        |    |                |          |            |                                          |
|                                                       | * In case of failing the first partial eliminatory exam, the exam must be done again on the date of the final exam. |    |                |          |            |                                          |
| Report of practices, practicum and external practices | Labs report                                                                                                         | 5  | A2<br>A3<br>A5 | B3<br>B4 | C21<br>C25 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
| Essay                                                 | Reports and presentations of essays proposed throughout the course during the internship sessions                   | 15 | A2<br>A3       | B3<br>B4 | C21<br>C25 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |

### Other comments on the Evaluation

The evaluation of the course at the first opportunity will be carried out by Ongoing Assessment. Students who have a justification may officially waive the ongoing assessment and ask for a first opportunity final exam, on the official date. The grade obtained in this exam will represent 100% of the final grade. This exam may have a part to do in a computer room and / or laboratory. The waiver of ongoing assessment must be made during the first month of class. During this period, the justification of the resignation will be presented to the coordinator of the subject for evaluation.

To pass the course at the first opportunity, a score greater than 5 points out of 10 will be required in the continuous evaluation during the development of classes and the exam on the official date, together. The final grade will be obtained according to the indicated percentages.

Ongoing assessment is not passed in the following cases:

- The non-execution or delivery, without justification, of any of the items of the ongoing assessment (works reports, practicum reports, exams ...). In this case, the final grade reflected in the official record will be "not presented"
- Obtaining a grade of less than 5 points out of 10 in the final exam of ongoing assessment. In this case, the final grade reflected in the official record will be the grade of the ongoing assessment final exam.

The evaluation of the course in the second opportunity will be carried out in a final exam on the date set by the center. The grade obtained in this exam will represent 100% of the final grade. This exam may have a part to do in a computer room and / or laboratory.

To pass the subject in the second opportunity, a score higher than 5 points out of 10 will be required in the exam on the official date.

The evaluation test schedule officially approved by the EEAE Center Board is published on the website <http://aero.uvigo.es/gl/docencia/exames>

The maximum length of the exams will be 3 hours if there is no interruption, and 5 hours if there is an intermediate break (maximum 3 hours for each part).

### Sources of information

#### Basic Bibliography

- C. Cuerno Rejado, **Aeronavegabilidad y certificación de aeronaves**, 1, Paraninfo, 2008
- F. de Florio, **Airworthiness. An introduction to aircraft certification and operations**, 3, Elsevier, 2016
- H.A. Kinnison, **Aviation maintenance management**, 2, McGraw-Hill, 2013
- EASA, **Especificaciones de Certificación europeas de EASA**,
- FAA, **Regulaciones Federales de Aviación de la FAA (EE.UU.)**,

#### Complementary Bibliography

### Recommendations

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**Subjects that it is recommended to have taken before**

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Aerospace technology/O07G410V01205

Air transport and airborne systems/O07G410V01404

Aerodynamics and aeroelasticity/O07G410V01923

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**Contingency plan**

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**Description**

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=== EXCEPTIONAL PLANNING ===

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

=== ADAPTATION OF THE METHODOLOGIES ===

\* Teaching methodologies maintained

The proposed methodologies are maintained but carried out through the Remote Campus. The platform faitic will be used more intensively as reinforcement to ensure accessibility of the students to the contents of the subject.

\* Teaching methodologies modified

Laboratory practices that require interaction with physical elements are replaced by other activities that can be carried out on the remote campus, such as work in groups.

\* Contactless mechanism for student attention (tutorials)

The tutorials will place in the teacher's virtual office on the remote campus.

=== ADAPTATION OF THE EVALUATION ===

\* Tests already carried out

The tests already carried out maintain their weight in the evaluation.

\* Pending tests

Pending tests are planned and will be carried out using the Moodle platform and the remote campus, and they maintain their weight in the evaluation.

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| IDENTIFYING DATA         |                                                                                                                                                                                                             |          |      |            |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Control and optimization |                                                                                                                                                                                                             |          |      |            |
| Subject                  | Control and optimization                                                                                                                                                                                    |          |      |            |
| Code                     | O07G410V01944                                                                                                                                                                                               |          |      |            |
| Study programme          | Grado en Ingeniería Aeroespacial                                                                                                                                                                            |          |      |            |
| Descriptors              | ECTS Credits                                                                                                                                                                                                | Choose   | Year | Quadmester |
|                          | 6                                                                                                                                                                                                           | Optional | 4th  | 1st        |
| Teaching language        | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                     |          |      |            |
| Department               |                                                                                                                                                                                                             |          |      |            |
| Coordinator              | García Rivera, Matías                                                                                                                                                                                       |          |      |            |
| Lecturers                | García Rivera, Matías                                                                                                                                                                                       |          |      |            |
| E-mail                   | mgrivera@uvigo.es                                                                                                                                                                                           |          |      |            |
| Web                      | http://faitic.uvigo.es                                                                                                                                                                                      |          |      |            |
| General description      | The aim of this subject is to present different technics of analysis and design of control systems, using classical and modern control. The technics of optimization are applied in problems of design.     |          |      |            |
|                          | English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English. b) tutoring sessions in English. c) exams and assessments in English. |          |      |            |

| <b>Competencies</b> |                                                                                                                                                                                                                                                                                    |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                |                                                                                                                                                                                                                                                                                    |
| A2                  | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study |
| A3                  | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                     |
| A5                  | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                       |
| C31                 | Appropriate knowledge applied to engineering: physical phenomena of air defense systems, their qualities and their control, stability and automatic control systems.                                                                                                               |
| D3                  | Capability of oral and written communication in native language                                                                                                                                                                                                                    |
| D4                  | Capability of autonomous learning and information management                                                                                                                                                                                                                       |
| D5                  | Capability to solve problems and draw decisions                                                                                                                                                                                                                                    |
| D6                  | Capability for interpersonal communication                                                                                                                                                                                                                                         |
| D8                  | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                |
| D11                 | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                      |
| D13                 | Sustainability and environmental commitment. Equitable, responsible and efficient use of resources                                                                                                                                                                                 |

| <b>Learning outcomes</b>                                                                                                                              |                               |     |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----|-----|
| Expected results from this subject                                                                                                                    | Training and Learning Results |     |     |
| RA01: The students have a global vision of the methods of optimisation and its applications, in particular in the modern technics of optimum control. | A2                            | C31 | D3  |
|                                                                                                                                                       | A3                            |     | D4  |
|                                                                                                                                                       | A5                            |     | D5  |
|                                                                                                                                                       |                               |     | D6  |
|                                                                                                                                                       |                               |     | D8  |
|                                                                                                                                                       |                               |     | D11 |
|                                                                                                                                                       |                               |     | D13 |

| <b>Contents</b>                          |  |
|------------------------------------------|--|
| Topic                                    |  |
| Introduction to optimization             |  |
| Methods of multidimensional optimization |  |
| Optimization with constraints            |  |
| Discrete and sampled systems             |  |
| Design of PID controllers                |  |
| State-Space                              |  |
| Linear-quadratic controller              |  |
| State Estimation                         |  |
| Linear-quadratic gaussian controller     |  |

Minimum variance control

Model predictive control

## Planning

|                                                       | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------------------|-------------|-----------------------------|-------------|
| Laboratory practical                                  | 18          | 0                           | 18          |
| Autonomous problem solving                            | 0           | 87.5                        | 87.5        |
| Lecturing                                             | 32          | 0                           | 32          |
| Report of practices, practicum and external practices | 0           | 10                          | 10          |
| 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                                                                                                          |
|----------------------------|----------------------------------------------------------------------------------------------------------------------|
| Laboratory practical       | Once developed the contents of theory and corresponding problems, students will make practices of laboratory.        |
| Autonomous problem solving | Once developed the contents of theory and corresponding problems, students will resolve problems of autonomous form. |
| Lecturing                  | The lecturer will explain the main of the contents of the matter. Active participation of the students is required.  |

## Personalized assistance

| Methodologies        | Description                                                                    |
|----------------------|--------------------------------------------------------------------------------|
| Lecturing            | The lecturer will advise the student with the items of theory given in classes |
| Laboratory practical | The lecturer will advise the student with the practices of laboratory          |

## Assessment

|                                                       | Description                                                                                                                                                                                 | Qualification | Training and Learning Results |     |                                          |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|-----|------------------------------------------|
| Laboratory practical                                  | In this test concepts given in practices of laboratory will be evaluated.<br><br>Learning outcomes evaluated RA01.                                                                          | 30            | A2<br>A3<br>A5                | C31 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
| Autonomous problem solving                            | The delivery of solutions to a set of exercises proposed evaluates the resolution of problems and/or exercises of autonomous form.<br><br>Learning outcomes evaluated RA01.                 | 5             | A2<br>A3<br>A5                | C31 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
| Report of practices, practicum and external practices | The delivery of this report of practices evaluates the assistance and active participation in the theoretical and practical classes and tutorship.<br><br>Learning outcomes evaluated RA01. | 5             | A2<br>A3<br>A5                | C31 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
| Essay questions exam                                  | This test evaluates theoretical concepts and the resolution of problems.<br><br>Learning outcomes evaluated RA01.                                                                           | 60            | A2<br>A3<br>A5                | C31 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |

## Other comments on the Evaluation

All references to numerical grades in this guide are about 10.

The dates of the final exams are published on the website of the EEAE in the web page

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

## ASSESSMENT CRITERIA FOR ASSISTANT STUDENTS IN THE 1st EDITION OF ACTS

An assistant student is defined as the one who delivers the solutions to a series of exercises carried out autonomously and a practical report.

For a assistant students in the first edition of acts, the evaluation consists of:

- Examination of development questions. In this test theoretical concepts and problem solving related to the theory are evaluated. Represents 6 points of the final grade. In necessary to obtain a minimum of 3 points.
- Laboratory practices. In this test, concepts given in laboratory practices are evaluated. It represents 3 points of the final grade. In necessary obtain a minimum of 1.5 points.
- Delivery of the solutions to a series of proposed exercises carried out autonomously. Represents 0.5 points of the final grade. In necessary obtain a minimum of 0.25 points.
- Delivery of a practice report. Represents 0.5 points of the final grade. In necessary obtain a minimum of 0.25 points.

In the case of not reaching the required minimum in any of the parts, the subject will not be approved, and the final grade of the subject will never exceed the grade of 4.9.

#### **EVALUATION CRITERIA FOR NON ASSISTANT STUDENTS IN THE 1st EDITION OF ACTS**

For non assistant students in the first edition of the proceedings, the evaluation consists of:

- Examination of development questions. In this test theoretical concepts and problem solving related to the theory are evaluated. Represents 6.5 points of the final grade. In necessary obtain a minimum of 3.25 points.
- Evaluation of laboratory practices. In this test concepts given in laboratory practices are evaluated. It represents 3.5 points of the final grade. In necessary obtain a minimum of 1.75 points.

In the case of not reaching the required minimum in any of the parts, the subject will not be approved, and the final grade of the subject will never exceed the grade of 4.9.

#### **ASSESSMENT CRITERIA FOR ASSISTANT AND NON ASSISTANT STUDENTS IN 2nd EDITION OF ACTS**

For all students, non assistant and assistant, in the second edition of the acts the evaluation consists of:

- Examination of development questions. In this test theoretical concepts and problem solving related to the theory are evaluated. Represents 6.5 points of the final grade. In necessary obtain a minimum of 3.25 points.
- Evaluation of laboratory practices. In this test, concepts given in laboratory practices are evaluated. It represents 3.5 points of the final grade. In necessary obtain a minimum of 1.75 points.

In the case of not reaching the required minimum in any of the parts, the subject will not be approved, and the final grade of the subject will never exceed the grade of 4.9.

#### **GRADING PROCESS**

In the case of not reaching the required minimum in any of the parts, the subject will not be approved, and the final grade of the subject will never exceed the grade of 4.9.

#### **PROHIBITION OF USE OF ANY ELECTRONIC DEVICE**

Students are reminded of the prohibition of the use of any electronic device in the evaluation tests, in compliance with article 13.2.d) of the Statute of University Students, related to the duties of university students, which establishes the duty to "Refrain from using or cooperation in fraudulent procedures in the evaluation tests, in the works that are carried out or in official documents of the university. "

**JUSTIFICATION OF ABSENCE** To be able to justify the absence to a test is necessary a Proof of Absence or a Consultation and Hospitalization Proof (also called P10) issued by a SERGAS doctor, or a certificate issued by a medical collegiate. A proof of the doctor's appointment will not be valid.

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#### **Sources of information**

##### **Basic Bibliography**

Domínguez, S.; Campoy, P.; Sebastián, J.M.; Jiménez, A., **CONTROL EN EL ESPACIO DE ESTADO**, 978-84-8322-297-3, 2a, Pearson Educación S.A., Madrid,, 2006

K. OGATA, **Ingeniería de control moderna**, 5a, PRENTICE-HALL, 2010

B. C. KUO, **Sistemas de control automático**, 7a, PRENTICE HALL, 1996

R. FLETCHER, **Methods of Optimization**, John Wiley & Sons, 2007

##### **Complementary Bibliography**

Moreno, Garrido, Balaguer, **Ingeniería de Control: modelado y control de sistemas dinámicos**, Ariel, 2003

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## Recommendations

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### Subjects that it is recommended to have taken before

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Electronics and automation/O07G410V01403

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## Contingency plan

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### Description

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=== EXCEPTIONAL PLANNING ===

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

#### SCENARIO 1: MIXED TEACHING

Due to the exceptional situation, given the impossibility of being able to teach completely in person, virtual means will be used to teach non-contact classes.

For the non-presential part, the means provided by the University, currently the <https://campusremotouvigo.gal/> and <https://fatic.uvigo.es>, will be used. It may also be supplemented by other means.

#### SCENARIO 2: NON-PRESENCE TEACHING

Due to the exceptional situation, given the impossibility of being able to teach completely in person, virtual means will be used to teach non-contact classes.

For the non-presential part, the means provided by the University, currently the <https://campusremotouvigo.gal/> and <https://fatic.uvigo.es>, will be used. It may also be supplemented by other means.

=== ADAPTATION OF THE METHODOLOGIES ===

\* Teaching methodologies maintained  
All of them

\* Teaching methodologies modified  
None of them

\* Non-attendance mechanisms for student attention (tutoring)  
<https://campusremotouvigo.gal/> and <https://fatic.uvigo.es>

\* Modifications (if applicable) of the contents  
No modifications

\* Additional bibliography to facilitate self-learning  
No additional bibliography

\* Other modifications  
For laboratory practices, the practices that require specific equipment will be replaced by another simulated or virtualized one. Eventually, alternative practices that do not require such equipment will be proposed. These practices may be an autonomous format in anticipation of reconciliation and / or connectivity problems.

=== ADAPTATION OF THE TESTS ===

\* Tests already carried out  
All tests already carried out maintain their weight

\* Pending tests that are maintained  
All pending tests maintain their weight

\* Tests that are modified  
No tests are modified

\* New tests

No new test

\* Additional Information

Due to the exceptional situation, due to the impossibility of being able to do the tests in person, virtual means will be used to carry out the tests.

The means provided by the University, currently <https://campusremotouvigo.gal/> and <https://fatic.uvigo.es> will be used. They may also be supplemented by other means.

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| <b>IDENTIFYING DATA</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |      |            |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| <b>Propulsion systems</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |      |            |
| Subject                   | Propulsion systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |      |            |
| Code                      | 007G410V01945                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |      |            |
| Study programme           | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |      |            |
| Descriptors               | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Choose   | Year | Quadmester |
|                           | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Optional | 4th  | 1st        |
| Teaching language         | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |      |            |
| Department                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |      |            |
| Coordinator               | Ulloa Sande, Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |      |            |
| Lecturers                 | Ulloa Sande, Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |      |            |
| E-mail                    | carlos.ulloa@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |      |            |
| Web                       | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |      |            |
| General description       | <p>The matter treats on the problems of development of the systems of propulsion used in aircraft and missiles. The systems of aeronautical and space propulsion are required to make a big variety of missions, covering from the very small push during several years of performance, characteristic of some systems of propulsion employed in satellites, until the very big push acting during time very short, like the thrusters of a space launcher or of an intercontinental ballistic missile.</p> <p>ateria del programa English Friendly: Los/as estudiantes internacionales podrán solicitar al profesorado: a) materiales y referencias bibliográficas para el seguimiento de la materia en inglés, b) atender las tutorías en inglés, c) pruebas y evaluaciones en inglés.</p> |          |      |            |

| <b>Competencies</b> |                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                |                                                                                                                                                                                                                                                                                                                                                                              |
| A2                  | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study                                                                                           |
| A3                  | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                                                                                                               |
| A5                  | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                                                                                                                 |
| B1                  | Capability for design, development and management in the field of aeronautical engineering (in according with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, aerospace propulsion systems, aerospace materials , airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems. |
| C29                 | Appropriate knowledge applied to engineering: concepts and laws that govern the internal combustion, its application to rocket propulsion.                                                                                                                                                                                                                                   |
| C33                 | Applied knowledge of aerodynamics, flight mechanics, air defense engineering (ballistics, missiles and air systems), space propulsion, material science and technology, structure theory.                                                                                                                                                                                    |
| D3                  | Capability of oral and written communication in native language                                                                                                                                                                                                                                                                                                              |
| D4                  | Capability of autonomous learning and information management                                                                                                                                                                                                                                                                                                                 |
| D5                  | Capability to solve problems and draw decisions                                                                                                                                                                                                                                                                                                                              |
| D6                  | Capability for interpersonal communication                                                                                                                                                                                                                                                                                                                                   |
| D8                  | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                                                                                                          |
| D11                 | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                                                                                                                |
| D13                 | Sustainability and environmental commitment. Equitable, responsible and efficient use of resources                                                                                                                                                                                                                                                                           |

| <b>Learning outcomes</b>                    |                                                                          |
|---------------------------------------------|--------------------------------------------------------------------------|
| Expected results from this subject          | Training and Learning Results                                            |
| - To know the propulsive needs of aircraft. | A2   B1   C29   D3<br>A3   C33   D4<br>A5   D5<br>D6<br>D8<br>D11<br>D13 |

|                                                                                                                                                                                                            |                |    |            |                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----|------------|------------------------------------------|
| - To know the thrusts and resistances related to the jet engines.                                                                                                                                          | A2<br>A3<br>A5 | B1 | C29        | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
| - To know and quantify in an applied way the combustion process of the jet engines and the combustion efficiency.                                                                                          | A2<br>A3<br>A5 | B1 | C29        | D4<br>D5<br>D8<br>D11<br>D13             |
| - To know how to perform an energy balance by differentiating and calculating the returns involved.                                                                                                        | A2<br>A3<br>A5 | B1 | C29        | D4<br>D5<br>D8<br>D11<br>D13             |
| - To know how to solve problems related to the calculation of thermodynamic cycles and the characteristics of the jetreactors; as well as the effect of the characteristics and quality of the components. | A2<br>A3<br>A5 | B1 | C29        | D4<br>D5<br>D8<br>D11<br>D13             |
| - To know the different jet engines and know how to obtain the optimal systems from the point of view of propulsive.                                                                                       | A2<br>A3<br>A5 | B1 | C29        | D3<br>D4<br>D5<br>D11<br>D13             |
| - To size the components that intervene in the propulsive system.                                                                                                                                          | A2<br>A3<br>A5 | B1 | C33        | D4<br>D5<br>D8                           |
| - To use computer tools to calculate the performance of air-reactors.                                                                                                                                      | A2<br>A3<br>A5 | B1 | C29        | D4<br>D5<br>D8                           |
| - To know the effect of flight conditions: speed and altitude in the operation of the air-reactors.                                                                                                        | A2<br>A3<br>A5 | B1 | C33        | D4<br>D8                                 |
| - To know the environmental problems of the jet engines and their possible solutions.                                                                                                                      | A2<br>A3<br>A5 | B1 | C29        | D4<br>D13                                |
| - To write technical reports and make oral technical presentations related to the above.                                                                                                                   | A2<br>A3<br>A5 | B1 | C29<br>C33 | D3<br>D6<br>D8<br>D11<br>D13             |
| - To solve problems derived from the field of the subject in an autonomous way and in collaboration with others.                                                                                           | A2<br>A3<br>A5 | B1 | C29<br>C33 | D5<br>D6<br>D8                           |
| - Knowledge and understanding of the laws that govern the movement of vehicles propelled with rocket engines; the generation of thrust and the variables on which it depends.                              | A2<br>A3       | B1 | C29        | D4<br>D8                                 |
| - Knowledge, understanding, application and analysis of the ideal model of the rocket engines with fluid dynamics propulsion and the influence of real effects.                                            | A2<br>A3<br>A5 | B1 | C29<br>C33 | D4<br>D5<br>D8                           |
| - Knowledge of the propellants and understanding and the combustion process of the rocket motors of solid, liquid and hybrid propellants.                                                                  | A2<br>A3<br>A5 | B1 | C29        | D4<br>D8                                 |
| - Knowledge, understanding, application and analysis of the ionization and acceleration system of electric rocket motors.                                                                                  | A2<br>A3<br>A5 | B1 | C33        | D4<br>D8                                 |
| - Knowledge, understanding, application and analysis of the feeding and cooling systems.                                                                                                                   | A2<br>A3<br>A5 | B1 | C33        | D4<br>D8                                 |
| - To train to understand and simulate the physical-mathematical processes of rocket engines and to address both the problem of actions such as the synthesis or design.                                    | A2<br>A3<br>A5 | B1 | C29<br>C33 | D4<br>D5<br>D8                           |

## Contents

### Topic

|                                |                                                                                                                                                                                                                                                                                               |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Block 1: Introduction          | Unit 1.1: Introduction to aircraft propulsion systems.<br>Unit 1.2: Alternative engines.<br>Unit 1.3: Turbo-propeller and turbo-shaft.                                                                                                                                                        |
| Block 2: Rockets               | Unit 2.1: Introduction<br>Unit 2.2: Description and operating principles<br>Unit 2.3: Chemical rockets<br>Unit 2.4: Electric propulsion                                                                                                                                                       |
| Block 3: Turbojet and turbofan | Topic 3.1: Turbojet and turbofan Engine Overview<br>Topic 3.2: Operation of the jet engine<br>Topic 3.3: Intake diffusers<br>Topic 3.4: Compressors<br>Topic 3.5: Combustion chambers<br>Topic 3.6: Turbines<br>Topic 3.7: Nozzles<br>Topic 3.8: Parametric analysis of turbojet and turbofan |

## Planning

|                                                       | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------------------|-------------|-----------------------------|-------------|
| Lecturing                                             | 28          | 0                           | 28          |
| Laboratory practical                                  | 12          | 0                           | 12          |
| Seminars                                              | 0           | 2                           | 2           |
| Previous studies                                      | 0           | 79.5                        | 79.5        |
| Objective questions exam                              | 2.5         | 0                           | 2.5         |
| Report of practices, practicum and external practices | 0           | 6                           | 6           |
| Essay                                                 | 10          | 10                          | 20          |

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

## Methodologies

|                      | Description                                                                                                                 |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Lecturing            | Classroom lectures                                                                                                          |
| Laboratory practical | Labs with different propulsion systems<br>Simulation labs of propulsion systems<br>Essays assignments on propulsion systems |
| Seminars             | Tutoring in small groups                                                                                                    |
| Previous studies     | Autonomous work                                                                                                             |

## Personalized assistance

### Methodologies Description

|          |                                                                                                                                                                       |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seminars | Small group tutoring with the teachers of the subject. The tutorials will be held, preferably, by appointment, in the teacher's virtual office, on the Remote Campus. |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## Assessment

|                                                       | Description                                                                                          | Qualification | Training and Learning Results |    |     |     |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|-----|-----|
| Objective questions exam                              | Partial exam of short questions and problems (20%)<br>(Percentage can be divided into shorter tests) | 70            | A2                            | B1 | C29 | D3  |
|                                                       |                                                                                                      |               | A3                            |    | C33 | D4  |
|                                                       | Final exam of short questions and problems (50%)                                                     |               | A5                            |    |     | D5  |
|                                                       |                                                                                                      |               |                               |    |     | D8  |
| Report of practices, practicum and external practices | Lab classes report                                                                                   | 10            |                               |    |     | D11 |
|                                                       |                                                                                                      |               |                               |    |     | D13 |
|                                                       |                                                                                                      |               | A2                            | B1 | C29 | D3  |
|                                                       |                                                                                                      |               | A3                            |    | C33 | D4  |
|                                                       |                                                                                                      |               | A5                            |    |     | D5  |
|                                                       |                                                                                                      |               |                               |    |     | D6  |
|                                                       |                                                                                                      |               |                               |    |     | D8  |
|                                                       |                                                                                                      |               |                               |    |     | D11 |
|                                                       |                                                                                                      |               |                               |    |     | D13 |

|       |                                                                                            |    |                |    |            |                                          |
|-------|--------------------------------------------------------------------------------------------|----|----------------|----|------------|------------------------------------------|
| Essay | Reports and presentations of essays proposed throughout the course during the lab sessions | 20 | A2<br>A3<br>A5 | B1 | C29<br>C33 | D3<br>D4<br>D5<br>D6<br>D8<br>D11<br>D13 |
|-------|--------------------------------------------------------------------------------------------|----|----------------|----|------------|------------------------------------------|

### Other comments on the Evaluation

The evaluation of the course at the first opportunity will be carried out by Ongoing Assessment. Students who have a justification may officially waive the ongoing assessment and ask for a first opportunity final exam, on the official date. The grade obtained in this exam will represent 100% of the final grade. This exam may have a part to do in a computer room and / or laboratory. The waiver of ongoing assessment must be made during the first month of class. During this period, the justification of the resignation will be presented to the coordinator of the subject for evaluation.

To pass the course at the first opportunity, a score greater than 5 points out of 10 will be required in the continuous evaluation during the development of classes and the exam on the official date, together. The final grade will be obtained according to the indicated percentages.

Ongoing assessment is not passed in the following cases:

- The non-execution or delivery, without justification, of any of the items of the ongoing assessment (works reports, practicum reports, exams ...). In this case, the final grade reflected in the official record will be "not presented"
- Obtaining a grade of less than 5 points out of 10 in the final exam of ongoing assessment. In this case, the final grade reflected in the official record will be the grade of the ongoing assessment final exam.

The evaluation of the course in the second opportunity will be carried out in a final exam on the date set by the center. The grade obtained in this exam will represent 100% of the final grade. This exam may have a part to do in a computer room and / or laboratory.

To pass the subject in the second opportunity, a score higher than 5 points out of 10 will be required in the exam on the official date.

The evaluation test schedule officially approved by the EEAE Center Board is published on the website <http://aero.uvigo.es/gl/docencia/exames>

The maximum length of the exams will be 3 hours if there is no interruption, and 5 hours if there is an intermediate break (maximum 3 hours for each part).

### Sources of information

#### Basic Bibliography

B. Galmés, **Motores de reacción y turbinas de gas**, 2, Paraninfo, 2018

J.D. Mattingly, **Elements of Propulsion: Gas Turbines and Rockets**, 2, AIAA Education Series, 2016

M. Cuesta, **Motores de reacción**, 9, Paraninfo, 2001

#### Complementary Bibliography

Y. Cengel, **Thermodynamics: An engineering approach**, 9 in SI, McGraw-Hill, 2019

### Recommendations

#### Subjects that it is recommended to have taken before

Aerospace technology/O07G410V01205

Fluid mechanics/O07G410V01402

Thermodynamics/O07G410V01303

Fluid mechanics II and CFD/O07G410V01922

### Contingency plan

#### Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering

safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

#### === ADAPTATION OF THE METHODOLOGIES ===

##### \* Teaching methodologies maintained

The proposed methodologies are maintained but carried out through the Remote Campus. The platform faitic will be used more intensively as reinforcement to ensure accessibility of the students to the contents of the subject.

##### \* Teaching methodologies modified

Laboratory practices that require interaction with physical elements are replaced by other activities that can be carried out on the remote campus, such as work in groups.

##### \* Contactless mechanism for student attention (tutorials)

The tutorials will place in the teacher's virtual office on the remote campus.

#### === ADAPTATION OF THE EVALUATION ===

##### \* Tests already carried out

The tests already carried out maintain their weight in the evaluation.

##### \* Pending tests

Pending tests are planned and will be carried out using the Moodle platform and the remote campus, and they maintain their weight in the evaluation.

---

| IDENTIFYING DATA        |                                                                                                                                                                                                                                                                                                                                                  |          |      |            |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Vehículos aeroespaciais |                                                                                                                                                                                                                                                                                                                                                  |          |      |            |
| Subject                 | Vehículos aeroespaciais                                                                                                                                                                                                                                                                                                                          |          |      |            |
| Code                    | 007G410V01946                                                                                                                                                                                                                                                                                                                                    |          |      |            |
| Study programme         | Grao en Enxeñaría Aeroespacial                                                                                                                                                                                                                                                                                                                   |          |      |            |
| Descriptors             | ECTS Credits                                                                                                                                                                                                                                                                                                                                     | Choose   | Year | Quadmester |
|                         | 6                                                                                                                                                                                                                                                                                                                                                | Optional | 4    | 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://aero.uvigo.es                                                                                                                                                                                                                                                                                                                             |          |      |            |
| General description     | A materia comprende o estudo do deseño preliminar de vehículos aeroespaciais. Faise unha análise xeral dos subsistemas e profúndase nos de análises de misión, control térmico, potencia, control de orientación, e estrutural. Así mesmo faise unha introdución aos sistemas de navegación e guiado de vehículos propulsados por motor foguete. |          |      |            |

## Competencias

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |  |  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| Code |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |  |  |
| A3   | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                                                                                                                                                                                                               |  |  |  |
| A5   | Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                                                                                                                                                                                                                       |  |  |  |
| B1   | Capacidade para o deseño, desenvolvemento e xestión no ámbito da enxeñaría aeronáutica que teñan por obxecto, de acordo cos coñecementos adquiridos segundo o establecido no apartado 5 da orde CIN/308/2009, os vehículos aeroespaciais, os sistemas de propulsión aeroespacial, os materiais aeroespaciais, as infraestruturas aeroportuarias, as infraestruturas de *aeronavegación e calquera sistema de xestión do espazo, do tráfico e do transporte aéreo. |  |  |  |
| B6   | Capacidade para participar nos programas de probas en voo para a toma de datos das distancias de despegamento, velocidades de ascenso, velocidades de perdas, maniobrabilidade e capacidades de aterraxe.                                                                                                                                                                                                                                                         |  |  |  |
| C27  | Coñecemento adecuado e aplicado á Enxeñaría de: Os fundamentos de sustentabilidade, mantenibilidade e operatividade dos sistemas espaciais.                                                                                                                                                                                                                                                                                                                       |  |  |  |
| C32  | Coñecemento adecuado e aplicado á Enxeñaría de: Os métodos de cálculo e de desenvolvemento dos materiais e sistemas da defensa; o manexo das técnicas experimentais, equipamento e instrumentos de medida propios da disciplina; a simulación numérica dos procesos físico-matemáticos máis significativos; as técnicas de inspección, de control de calidade e de detección de fallos; os métodos e técnicas de reparación máis adecuados.                       |  |  |  |
| D6   | Capacidade de comunicación interpersoal                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |
| D8   | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| D11  | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |
| D13  | Sustentabilidade e compromiso ambiental. Uso equitativo, responsable e eficiente dos recursos                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |

## Resultados de aprendizaxe

| Expected results from this subject                                                                                 | Training and Learning Results |    |     |            |
|--------------------------------------------------------------------------------------------------------------------|-------------------------------|----|-----|------------|
| Coñecemento, comprensión e aplicación das configuracións, subsistemas e misións dos mísiles e vehículos espaciais. | A3                            | B1 | C27 | D6<br>D8   |
| Coñecemento, comprensión, aplicación e análise do deseño aerodinámico e guiado de mísiles e vehículos espaciais    | A5                            | B6 | C32 | D11<br>D13 |

## Contidos

|                                                                                                                                                                              |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Topic                                                                                                                                                                        |  |
| 1.Deseño preliminar de aeronaves                                                                                                                                             |  |
| 2. Tipos e clasificación de mísiles e subsistemas. Subsistemas de navegación, guiado e control de mísiles                                                                    |  |
| 3. Tipos e clasificación de vehículos espaciais. Análise de misión. Análise xeral dos subsistemas. Subsistema de control térmico. Subsistema de control de actitude e órbita |  |

## Planificación

|                                           | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------|-------------|-----------------------------|-------------|
| Resolución de problemas                   | 16          | 0                           | 16          |
| Prácticas de laboratorio                  | 4           | 0                           | 4           |
| Estudo de casos                           | 8           | 0                           | 8           |
| Resolución de problemas de forma autónoma | 0           | 97.5                        | 97.5        |
| Lección maxistral                         | 22          | 0                           | 22          |
| Exame de preguntas obxectivas             | 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.

### Metodoloxía docente

|                                           | Description                                                                                                                                                                                                     |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Resolución de problemas                   | Resolución de problemas e/ou exercicios que tratan aspectos puntuais dun subsistema, e que á súa vez todos xuntos abordan un problema máis global dese subsistema de vehículos aeroespaciais.                   |
| Prácticas de laboratorio                  | Realización dunha práctica programada relacionada cun subsistema de vehículo espacial. A realización da práctica require a preparación da mesma, a asistencia e a realización dun informe por parte do alumnado |
| Estudo de casos                           | Formulación de casos a estudar de subsistemas de vehículos espaciais, que implican a resolución dun ou varios problemas, a realizar polo alumnado individualmente e/ou en grupo na aula.                        |
| Resolución de problemas de forma autónoma | Estudo do alumnado de forma autónoma, co apoio do profesorado si así o require segundo os procedementos establecidos pola universidade                                                                          |
| Lección maxistral                         | Exposición dun tema por parte do profesorado segundo un guión previamente establecido                                                                                                                           |

### Atención personalizada

| Tests                         | Description                                                                                                                      |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Exame de preguntas obxectivas | O alumno estuda de forma autónoma, co apoio do profesor si así o require segundo os procedementos establecidos pola universidade |

### Avaliación

|                               | Description                                                                             | Qualification | Training and Learning Results |          |            |                        |
|-------------------------------|-----------------------------------------------------------------------------------------|---------------|-------------------------------|----------|------------|------------------------|
| Prácticas de laboratorio      | Avaliación da realización do informe.                                                   | 20            | A3<br>A5                      | B1<br>B6 | C27<br>C32 | D11                    |
| Estudo de casos               | Avaliación da resolución dun ou varios problemas plantexados como casos de subsistemas. | 20            | A3<br>A5                      | B1<br>B6 | C27<br>C32 | D6<br>D8<br>D11<br>D13 |
| Exame de preguntas obxectivas | Resolución de problemas e/ou preguntas conceptuais sobre os contidos da materia         | 60            | A3<br>A5                      | B1<br>B6 | C27<br>C32 | D8<br>D11<br>D13       |

### Other comments on the Evaluation

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>

### Primeira edición de actas

#### (1) Estudiantes que seguen o curso por Avaliación Continua:

Para poder superar a materia na primeira edición de actas, mediante Avaliación Continua, será necesario:

-Unha nota, no exame final de avaliación continua, non inferior a 4.0.

-Entregar todas as prácticas e traballos da materia obtendo, como mínimo, unha nota de 3 en cada un deles.

No caso de non cumprir ditas condicións a nota final será a resultante do mínimo da nota media de EC e de 4.0.

#### (2) Estudiante que, tras unha autorización por parte do profesorado, renuncien á Avaliación Continua:

A avaliación do curso na primeira edición de acta realizarase, por defecto, mediante a Avaliación Continua.

Os estudantes que teñan unha xustificación poderán renunciar oficialmente á avaliación continua e realizar un só exame final, na data oficial. A nota obtida neste exame representará o 100% da nota final. O alumno deberá superar o 5 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

A renuncia á avaliación continua debe facerse durante o primeiro mes de clase. Durante este período, presentarase o xustificante ao coordinador da materia para a súa avaliación.

## **Segunda edición de actas.**

Os alumnos que non superasen a materia na primeira edición de actas poderán realizarán un exame que supoñerá o 100% da nota. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

O Estatuto do Estudante Universitario, establece que o estudante universitario ten o deber de "absterse da utilización ou cooperación en procedementos fraudulentos nas probas de avaliación, nos traballos que se realicen ou en documentos oficiais da universidade". Por iso, espérase que o alumno teña un comportamento ético adecuado. Se se detectase un comportamento pouco ético durante o curso (copia, plaxio, uso de dispositivos electrónicos non autorizados ou outros), penalizarase ao alumno cunha nota de 0,0 na proba escrita ou entregable onde se detectase devandita fraude.

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## **Bibliografía. Fontes de información**

### **Basic Bibliography**

Larson W. J., Wertz J.R., **Space Mission Analysis and Design**, 3, Springer Netherlands, 1999

### **Complementary Bibliography**

Fortescue P., Stark J., Swinerd G., **Spacecraft Systems Engineering**, 3, Wiley, 2003

Gilmore D. G., **Spacecraft Thermal Control Handbook**, 2, The Aerospace Press., 2002

Tewari A., **Advanced Control of Aircraft, Spacecraft and Rockets**, 1, John Wiley & Sons, 2011, 2011

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## **Recomendacións**

### **Subjects that are recommended to be taken simultaneously**

Control e optimización/O07G410V01944

### **Subjects that it is recommended to have taken before**

Mecánica analítica e orbital/O07G410V01943

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## **Plan de Continxencias**

### **Description**

=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===

Ante a incerta e imprevisible evolución da alerta sanitaria provocada pola COVID-19, a Universidade establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determinen, atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou non totalmente presencial.

Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dunha maneira mais áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado, e o profesorado, a través da ferramenta normalizada e institucionalizada das guías docentes DOCNET.

#### **Escenario 1: Docencia mixta**

Debido á situación excepcional, #ante a imposibilidade de poder impartir a docencia dun modo totalmente presencial, utilizaranse medios virtuais tanto síncronas como asíncronas para a impartición das clases que sexan habilitadas pola Universidade de Vigo.

As prácticas serán entregadas polos estudantes e avaliadas empregando os recursos da plataforma de teledocencia dispoñible no seu momento.

As sesións de tutorización, tanto o nivel individual como o nivel de grupos poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, salgas/aulas/despachos virtuais proporcionadas pola Universidade de Vigo).

#### **Escenario 2: Docencia non-presencial**

Debido á situación excepcional, #ante a imposibilidade de poder impartir a docencia dun modo presencial, utilizaranse medios virtuais para a impartición das clases que sexan habilitadas pola Universidade de Vigo.

As prácticas serán entregadas polos estudantes e avaliadas empregando os recursos da plataforma de teledocencia dispoñible no seu momento.

As sesións de tutorización poderán realizarse por medios telemáticos (correo electrónico, videoconferencia, salgas/aulas/despachos virtuais proporcionadas pola Universidade de Vigo).

=== ADAPTACIÓN DAS METODOLOXÍAS ===

As metodoloxías docentes que se manteñen principalmente cunha posible modificación temporal na planificación segundo situación concreta.

Non procede ningunha modificacións dos contidos para impartir.

Auméntase a bibliografía co material de elaboración propia (por exemplo, guías de traballo, vídeos e textos explicativos, problemas resoltos, etc.) para facilitar a auto-aprendizaxe.

=== ADAPTACIÓN DA AVALIACIÓN ===

As probas mantéñense coas súas ponderacións previstas.

---

| IDENTIFYING DATA      |                                                                                                                                                                                                                                     |          |      |            |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------------|
| Prácticas en empresas |                                                                                                                                                                                                                                     |          |      |            |
| Subject               | Prácticas en empresas                                                                                                                                                                                                               |          |      |            |
| Code                  | 007G410V01981                                                                                                                                                                                                                       |          |      |            |
| Study programme       | Grao en Enxeñaría Aeroespacial                                                                                                                                                                                                      |          |      |            |
| Descriptors           | ECTS Credits                                                                                                                                                                                                                        | Choose   | Year | Quadmester |
|                       | 6                                                                                                                                                                                                                                   | Optional | 4    | 2c         |
| Teaching language     | Castelán Galego                                                                                                                                                                                                                     |          |      |            |
| Department            | Enxeñaría mecánica, máquinas e motores térmicos e fluídos                                                                                                                                                                           |          |      |            |
| Coordinator           | Martín Ortega, Elena Beatriz                                                                                                                                                                                                        |          |      |            |
| Lecturers             | Martín Ortega, Elena Beatriz                                                                                                                                                                                                        |          |      |            |
| E-mail                | emortega@uvigo.es                                                                                                                                                                                                                   |          |      |            |
| Web                   | http://http://aero.uvigo.es/                                                                                                                                                                                                        |          |      |            |
| General description   | Mediante a realización de prácticas en empresa o alumno 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. |          |      |            |

| Competencias |                                                                                                                                                                                                                                                                                                                |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code         |                                                                                                                                                                                                                                                                                                                |
| A2           | Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo                                           |
| A3           | Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitir xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética                                                                            |
| A4           | Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado como non especializado                                                                                                                                                                          |
| A5           | Que os estudantes desenvolvesen aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores cun alto grao de autonomía                                                                                                                                                                    |
| C6           | Coñecemento adecuado do concepto de empresa, marco institucional e xurídico da empresa. Organización e xestión de empresas.                                                                                                                                                                                    |
| C19          | Coñecemento aplicado de: a ciencia e tecnoloxía dos materiais; mecánica e termodinámica; mecánica de fluídos; aerodinámica e mecánica do voo; sistemas de navegación e circulación aérea; tecnoloxía aeroespacial; teoría de estruturas; transporte aéreo; economía e produción; proxectos; impacto ambiental. |
| D2           | Liderado, iniciativa e espírito emprendedor                                                                                                                                                                                                                                                                    |
| D3           | Capacidade de comunicación oral e escrita na lingua nativa                                                                                                                                                                                                                                                     |
| D4           | Capacidade de aprendizaxe autónoma e xestión da información                                                                                                                                                                                                                                                    |
| D11          | Ter motivación pola calidade con sensibilidade cara a temas do ámbito dos estudos                                                                                                                                                                                                                              |
| D12          | Compromiso ético e democrático                                                                                                                                                                                                                                                                                 |

| Resultados de aprendizaxe                                                                                                                                                                          |                               |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----|-----|
| Expected results from this subject                                                                                                                                                                 | Training and Learning Results |     |     |
| Coñecemento, comprensión e aplicación da organización e planificación dunha empresa ou institución do sector aeroespacial.                                                                         | C6                            |     |     |
| Coñecemento, comprensión e aplicación dos equipos de traballo, do traballo en equipo e da comunicación oral e escrita en empresas e institucións do sector aeroespacial, nacionais ou estranxeiras | A3                            | D2  |     |
|                                                                                                                                                                                                    | A4                            | D3  |     |
|                                                                                                                                                                                                    | A5                            | D4  |     |
|                                                                                                                                                                                                    |                               | D11 |     |
| Coñecemento, comprensión, aplicación, análise e síntese de distintos problemas técnicos concretos que aparecen nas empresas, aplicando con creatividade os coñecementos adquiridos na carreira     |                               | D12 |     |
|                                                                                                                                                                                                    | A2                            | C19 | D12 |

| Contidos |
|----------|
| Topic    |

Coñecemento xeral por parte do estudante da 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 da memoria final sobre o traballo realizado xunto cos formularios oficiais requeridos

## 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

## Avaliación

|                                          | Description                                                                                                                          | Qualification | Training and Learning Results |        |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|--------|
| Prácticum, Practicas externas e clínicas | Avaliación por parte do titor da empresa durante o desenvolvemento das prácticas (informe oficial D5)                                | 100           | A2                            | C6 D2  |
|                                          | Avaliación da memoria de prácticas entregada polo alumno ao finalizar a realización das mesmas.                                      |               | A3                            | C19 D3 |
|                                          | Avaliación do informe do titor académico designado polo centro.                                                                      |               | A4                            | D4     |
|                                          | Os estudantes en prácticas deberán manter un contacto continuado non só co seu titor na empresa, senón tamén co seu titor académico. |               | A5                            | D11    |
|                                          | Ao concluír as prácticas, os alumnos deberán entregar ao seu titor académico unha memoria final e o informe en documento oficial D6- |               |                               | D12    |
|                                          | Informe do estudante.                                                                                                                |               |                               |        |
|                                          | Na avaliación terase en conta o seguimento realizado polo titor académico e os informes entregados polo alumno.                      |               |                               |        |

## Other comments on the Evaluation

Esta materia réxese polo establecido no regulamento de prácticas en empresa do centro:

[http://aero.uvigo.es/images/docs/escuela/normativa/Practicas\\_EEAE.pdf](http://aero.uvigo.es/images/docs/escuela/normativa/Practicas_EEAE.pdf)

## Bibliografía. Fontes de información

### Basic Bibliography

### Complementary Bibliography

## Recomendacións

**Description**

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**=== MEDIDAS EXCEPCIONAIS PLANIFICADAS ===**

Ante a incerta e imprevisible evolución da alerta sanitaria provocada polo \*COVID-19, a Universidade de Vigo establece unha planificación extraordinaria que se activará no momento en que as administracións e a propia institución determinen atendendo a criterios de seguridade, saúde e responsabilidade, e garantindo a docencia nun escenario non presencial ou parcialmente presencial. Estas medidas xa planificadas garanten, no momento que sexa preceptivo, o desenvolvemento da docencia dun modo máis áxil e eficaz ao ser coñecido de antemán (ou cunha ampla antelación) polo alumnado e o profesorado a través da ferramenta normalizada e institucionalizada das guías docentes.

**=== ADAPTACIÓN DAS METODOLOXÍAS ===**

Adaptarase a materia seguindo en todo momento os cambios indicados desde a reitoría da Universidade de Vigo.

Mecanismo non presencial de atención ao alumnado (titorías): Realizarase o seguimento das titorías mediante ferramentas virtuais (despacho virtual en campus remoto ou ferramentas similares) e/ou email

Modificacións (si proceden) dos contidos a impartir: En caso de crise sanitaria realizaranse de forma telemática, sempre que a empresa estea de acordo. Así mesmo, en caso de crise, unha porcentaxe do número de horas poderán completarse mediante a realización de cursos on-line relacionados coa temática da materia (por exemplo cursos organizados pola área de emprego da Universidade). Estes cursos deben contar coa aprobación previa a súa realización do titor académico das prácticas en empresa para poder ser recoñecidos como parte da materia

Bibliografía adicional para facilitar o auto-aprendizaxe: Non é necesario

**=== ADAPTACIÓN DA AVALIACIÓN ===**

Non hai probas adicionais. En caso de realizar cursos (aprobados polo coordinador académico das prácticas en empresa) para completar o número de horas serán valorados.

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| IDENTIFYING DATA        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |      |            |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------|------------|
| Final Year Dissertation |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |      |            |
| Subject                 | Final Year Dissertation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |      |            |
| Code                    | 007G410V01991                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |      |            |
| Study programme         | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |      |            |
| Descriptors             | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Choose    | Year | Quadmester |
|                         | 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Mandatory | 4th  | 2nd        |
| Teaching language       | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |      |            |
| Department              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |      |            |
| Coordinator             | Ulloa Sande, Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |      |            |
| Lecturers               | Ulloa Sande, Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |      |            |
| E-mail                  | carlos.ulloa@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |      |            |
| Web                     | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |      |            |
| General description     | <p>The Final Degree Project (TFG) is an original and personal work that each student will carry out independently under the tutorship of the academic staff and will allow them to demonstrate, in an integrated manner, the acquisition of the knowledge and the competences associated with the degree.</p> <p>English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.</p> |           |      |            |

| Competencies |                                                                                                                                                                                                                                                                                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code         |                                                                                                                                                                                                                                                                                    |
| A2           | That the students know how to apply their knowledge to their work or vocation in a professional way and that they possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study |
| A3           | That the students have the capability to gather and interpret relevant data (usually within their area of study) to issue judgments that include a reflection on relevant social, scientific or ethical issues                                                                     |
| A4           | That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized audience                                                                                                                                                            |
| A5           | That the students develop those learning capabilities necessary to undertake further studies with a high degree of autonomy.                                                                                                                                                       |
| D2           | Leadership, initiative and entrepreneurship                                                                                                                                                                                                                                        |
| D3           | Capability of oral and written communication in native language                                                                                                                                                                                                                    |
| D4           | Capability of autonomous learning and information management                                                                                                                                                                                                                       |
| D5           | Capability to solve problems and draw decisions                                                                                                                                                                                                                                    |
| D6           | Capability for interpersonal communication                                                                                                                                                                                                                                         |
| D7           | Capability to adapt to new situations with creativity and innovation                                                                                                                                                                                                               |
| D8           | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                |
| D9           | Capability to work in interdisciplinary teams                                                                                                                                                                                                                                      |
| D10          | Capability to negotiate and deal with and act in situations of conflict                                                                                                                                                                                                            |
| D11          | Show motivation for quality with sensitivity towards subjects within the scope of the studies                                                                                                                                                                                      |
| D12          | Ethical and democratic commitment                                                                                                                                                                                                                                                  |
| D13          | Sustainability and environmental commitment. Equitable, responsible and efficient use of resources                                                                                                                                                                                 |

| Learning outcomes                                                                                                                                                                                                                                                                 |                               |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----|
| Expected results from this subject                                                                                                                                                                                                                                                | Training and Learning Results |     |
| (*)O estudante obterá un coñecemento de os procesos de creación e produción artística.                                                                                                                                                                                            |                               |     |
| Realization of a personal and original work, both in the title and in the contents, carried out autonomously under teacher tutoring, which must allow the acquisition of the training contents and the competences associated with the title to be shown in an integrated manner. | A2                            | D2  |
|                                                                                                                                                                                                                                                                                   | A3                            | D3  |
|                                                                                                                                                                                                                                                                                   | A4                            | D4  |
|                                                                                                                                                                                                                                                                                   | A5                            | D5  |
|                                                                                                                                                                                                                                                                                   |                               | D6  |
|                                                                                                                                                                                                                                                                                   |                               | D7  |
|                                                                                                                                                                                                                                                                                   |                               | D8  |
|                                                                                                                                                                                                                                                                                   |                               | D9  |
|                                                                                                                                                                                                                                                                                   |                               | D10 |
|                                                                                                                                                                                                                                                                                   |                               | D11 |
|                                                                                                                                                                                                                                                                                   |                               | D12 |
|                                                                                                                                                                                                                                                                                   |                               | D13 |

| <b>Contents</b>                                 |                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                           |                                                                                                                                                                                                                                                                                                                                                                                       |
| Classical projects of aerospace engineering     | For example, the design and even the manufacture of a prototype, the engineering of a production facility or the implementation of a system in any aerospace field.                                                                                                                                                                                                                   |
| Technical studies, organisational and economic. | Reports related to equipment, materials, systems, services, etc., in the fields of aerospace engineering, dealing with one or more aspects related to design, planning, production, management, exploitation and any other engineering field. They must compare technical alternatives to economic evaluations and allow the discussion and evaluation of the results when necessary. |
| Theoretical works-experimental                  | Theoretical-experimental nature works, which contribute to the technique in different fields of engineering, including, when appropriate, the evaluation and economic discussion and evaluation of the results.                                                                                                                                                                       |

| <b>Planning</b>        |             |                             |             |
|------------------------|-------------|-----------------------------|-------------|
|                        | 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.

| <b>Methodologies</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Previous studies       | Autonomous work aimed at the acquisition of theoretical knowledge.                                                                                                                                                                                                                                                                                                                                                                |
| Project based learning | Oriented to practical application.                                                                                                                                                                                                                                                                                                                                                                                                |
| Mentored work          | Dedication of the student at the facilities of the School of Aeronautical Engineering and Space: <ul style="list-style-type: none"> <li>- Student assistance to the school laboratories for the development of the project.</li> <li>- Tutorials with the tutor and / or co-tutor. Meetings with the student dedicated to the application of methods and techniques, review of documents, presentation rehearsal, etc.</li> </ul> |

### Personalized assistance

| Methodologies | Description                          |
|---------------|--------------------------------------|
| Mentored work | Tutorials with tutor and/or co-tutor |

| <b>Assessment</b> |                                                                                                                   |               |                               |     |
|-------------------|-------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|-----|
|                   | Description                                                                                                       | Qualification | Training and Learning Results |     |
| Project           | Tutor evaluation of the project: 25%                                                                              | 75            | A2                            | D2  |
|                   |                                                                                                                   |               | A3                            | D3  |
|                   | Academic tribunal evaluation: 50%                                                                                 |               | A4                            | D4  |
|                   | - Evaluation of the scope of the project. The scientific-technical difficulty of the work will be evaluated (25%) |               | A5                            | D5  |
|                   |                                                                                                                   |               |                               | D6  |
|                   | - Evaluation of the documentation. The quality of the TFG memory will be evaluated (25%)                          |               |                               | D7  |
|                   |                                                                                                                   |               |                               | D8  |
|                   |                                                                                                                   |               |                               | D9  |
|                   |                                                                                                                   |               |                               | D10 |
|                   |                                                                                                                   |               |                               | D11 |
|                   |                                                                                                                   |               |                               | D12 |
|                   |                                                                                                                   |               |                               | D13 |

|              |                                                                                                                                                                                             |    |    |     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|-----|
| Presentation | Academic tribunal evaluation: 25%                                                                                                                                                           | 25 | A2 | D2  |
|              | - Evaluation of the presentation. Aspects such as clarity in the presentation, use of time, quality of the material used and answering the questions of the tribunal members are evaluated. |    | A3 | D3  |
|              |                                                                                                                                                                                             |    | A4 | D4  |
|              |                                                                                                                                                                                             |    | A5 | D5  |
|              |                                                                                                                                                                                             |    |    | D6  |
|              |                                                                                                                                                                                             |    |    | D7  |
|              |                                                                                                                                                                                             |    |    | D8  |
|              |                                                                                                                                                                                             |    |    | D9  |
|              |                                                                                                                                                                                             |    |    | D10 |
|              |                                                                                                                                                                                             |    |    | D11 |
|              |                                                                                                                                                                                             |    |    | D12 |
|              |                                                                                                                                                                                             |    |    | D13 |

### Other comments on the Evaluation

The TFG is an original exercise that is carried out individually, is presented in front an academic tribunal. It must be a project in the field of specific technologies of Aerospace engineering, with a professional nature, in which students synthesize and integrate the competences acquired during their studies. The performance and evaluation of the TFG is regulated by active regulations of University of Vigo and EEAE.

### Sources of information

#### Basic Bibliography

#### Complementary Bibliography

### Recommendations

#### Other comments

Ethical commitment: student must present a suitable ethical behaviour. If a no ethical behaviour (cheating, plagiarism, or others) is detected, a fail (0,0) will be the global mark for the student.

Requirements: Enrollment in TFG course must be done only if the students enroll in all the remaining subjects necessary to get their degree..

Important information: The TFG only can be presented and evaluated if there are objective evidence that the students passed all the other necessary subjects to obtain their degree, according to the University of Vigo TFG Regulation, approved on 5th of June of 2016 and modified on 13 of November of 2018.

Plagiarism will be prosecuted using plagiarism software tool.

### Contingency plan

#### Description

=== EXCEPTIONAL PLANNING ===

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

=== ADAPTATION OF THE METHODOLOGIES ===

\* Teaching methodologies maintained

The teaching methodologies are maintained except in the experimental content works that will modify their focus and their contents to adapt to the impossibility of attending the center.

\* Teaching methodologies modified

Tutored work:

- Attendance to laboratories: it will be supplemented by tutorials with the tutor and / or co-tutor.

- Tutorials with tutor and / or co-tutor: alternatively, they will be held through the Remote Campus platform of the University of Vigo.

\* Non-attendance mechanisms for student attention (tutoring)

The tutoring sessions will be held, alternatively, by telematic means (email or videoconference) under the modality of prior

agreement.

\* Modifications (if applicable) of the contents

The works of experimental content will modify their approach and their contents to adapt to the impossibility of attending the center.

=== ADAPTATION OF THE TESTS ===

\* Tests that are modified

In case of no attendance, the defenses of the works will be carried out on the Remote Campus platform.

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