



## (\*)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

Pavillón Manuel Martínez-Risco

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 1st

| Code          | Name                                         | Quadmester | Total Cr. |
|---------------|----------------------------------------------|------------|-----------|
| 007G410V01101 | Mathematics: Calculus I                      | 1st        | 6         |
| 007G410V01102 | Mathematics: Linear algebra                  | 1st        | 6         |
| 007G410V01103 | Physics: Physics I                           | 1st        | 6         |
| 007G410V01104 | Computer science                             | 1st        | 6         |
| 007G410V01105 | Graphic expression: Graphic expression       | 1st        | 6         |
| 007G410V01201 | Mathematics: Calculus II                     | 2nd        | 6         |
| 007G410V01202 | Physics: Physics II                          | 2nd        | 6         |
| 007G410V01203 | Chemistry: Chemistry                         | 2nd        | 6         |
| 007G410V01204 | Business: business technology and management | 2nd        | 6         |
| 007G410V01205 | Aerospace technology                         | 2nd        | 6         |



| IDENTIFYING DATA        |                                                                                                                                                                                                                                                      |                 |      |            |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| Mathematics: Calculus I |                                                                                                                                                                                                                                                      |                 |      |            |
| Subject                 | Mathematics:<br>Calculus I                                                                                                                                                                                                                           |                 |      |            |
| Code                    | 007G410V01101                                                                                                                                                                                                                                        |                 |      |            |
| Study programme         | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                     |                 |      |            |
| Descriptors             | ECTS Credits                                                                                                                                                                                                                                         | Choose          | Year | Quadmester |
|                         | 6                                                                                                                                                                                                                                                    | Basic education | 1st  | 1st        |
| Teaching language       | #EnglishFriendly<br>Galician<br>English                                                                                                                                                                                                              |                 |      |            |
| Department              |                                                                                                                                                                                                                                                      |                 |      |            |
| Coordinator             | Area Carracedo, Iván Carlos                                                                                                                                                                                                                          |                 |      |            |
| Lecturers               | Area Carracedo, Iván Carlos                                                                                                                                                                                                                          |                 |      |            |
| E-mail                  | area@uvigo.gal                                                                                                                                                                                                                                       |                 |      |            |
| Web                     | http://area.webs.uvigo.es                                                                                                                                                                                                                            |                 |      |            |
| General description     | The aim of this course is that the student acquires the techniques of differential calculus both in one and several variables, and integral calculus in one variables, necessary both for other courses of the degree and for professional practice. |                 |      |            |
|                         | International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.                                                                    |                 |      |            |

### Training and Learning Results

|      |                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                                                                                                    |
| A1   | That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study                                                                                    |
| B2   | Planning, documentation, project management, calculation and manufacturing in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.        |
| C1   | Capability to solve mathematical problems that may arise in engineering. Aptitude to apply the knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization.                                                                       |
| C32  | Appropriate knowledge applied to engineering: methods of calculation and development of materials and defence systems; management of experimental techniques, equipment and measuring instruments; numerical simulation of the most significant physical-mathematical processes; inspection, quality control and fault detection techniques; their most appropriate methods and repair techniques. |
| D1   | Capability of analysis, organization and planification.                                                                                                                                                                                                                                                                                                                                            |
| 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                                                                                                                                                                                                                                                                                                                                                |

### Expected results from this subject

| Expected results from this subject                                                                                                                                                              | Training and Learning Results |    |           |                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|-----------|----------------------------------|
| Knowledge and understanding of the main concepts and techniques of differential calculus in one and several variables as well as of integral calculus in one variable and numerical integration | A1                            | B2 | C1<br>C32 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |

### Contents

| Topic                           |                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------|
| Sequences and series.           | Sequences and series. Convergence. Numeric series of positive terms. Convergence criteria. Power series. |
| Functions of one real variable. | Functions of one real variable. Limits. Continuity.                                                      |

|                                                                                                                             |                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Differentiability of functions of one real variable. Mean value theorems. Limited expansions and Taylor's formula. Extrema. | Differentiability of functions of one real variable. Mean value theorems. Limited expansions and Taylor's formula. Extrema.                                                                |
| Integration of functions of one real variable                                                                               | Primitives. Definite integral. Fundamental theorem of calculus. Geometric applications. Numerical integration                                                                              |
| Functions of several real variables.                                                                                        | The n-dimensional euclidean space. Functions of several real variables. Limits. Continuity. Differentiability. Expansion and Taylor's formula. Relative extrema. Constrained optimization. |

## Planning

|                            | Class hours | Hours outside the classroom | Total hours |
|----------------------------|-------------|-----------------------------|-------------|
| Lecturing                  | 18          | 36                          | 54          |
| Problem solving            | 14          | 26.6                        | 40.6        |
| Introductory activities    | 1           | 1.4                         | 2.4         |
| Autonomous problem solving | 5           | 9.5                         | 14.5        |
| Practices through ICT      | 12          | 24                          | 36          |
| Essay questions exam       | 2.5         | 0                           | 2.5         |

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

## Methodologies

|                            | Description                                                                                                                                                                                     |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lecturing                  | The professor will present in the theoretical classes the contents of the subject. Students will have basic reference texts for tracking the subject.                                           |
| Problem solving            | The professor will solve problems and exercises manually and the student will have to solve similar exercises to acquire the necessary skills.                                                  |
| Introductory activities    | Activities to make contact and gather information on the students, and to present the subject.                                                                                                  |
| Autonomous problem solving | The students will have to solve exercises independently to check the acquisition of the skills.                                                                                                 |
| Practices through ICT      | The professor will solve problems and exercises, similar to those analyzed in lectures, with computer tools. The students will have to solve similar exercises to acquire the necessary skills. |

## Personalized assistance

### Methodologies Description

|                 |                                                                                                                                                                                                                                         |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lecturing       | The professor will personally solve the doubts of students. The doubts will be solved in-person, specially during problems and laboratory lectures and during tutorials, and also by using the remote options available for the course. |
| Problem solving | The professor will personally solve the doubts of students. The doubts will be solved in-person, specially during problems and laboratory lectures and during tutorials, and also by using the remote options available for the course. |

## Assessment

|                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Qualification | Training and Learning Results |    |    |                                  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|----|----------------------------------|
| Autonomous problem solving | A written exam will be carried out at the end of the first part of the subject (sequences and series) to evaluate the solution of exercises and/or problems autonomously, which will account for 20% of the qualification. Another written test will be carried out at the end of the second part of the subject (calculus in one variable) also to evaluate the solution of exercises and/or problems autonomously which will account for 30% of the qualification. In addition, the practices will be evaluated from the second session, with 10% of the qualification for this section. | 50            | A1                            | B2 | C1 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |
| Practices through ICT      | (*)Avaliaranse as prácticas a partir da segunda sesión, cun 10% da cualificación por este apartado pola totalidade das prácticas da segunda á sexta sesión.                                                                                                                                                                                                                                                                                                                                                                                                                                | 10            |                               | B2 | C1 | D1<br>D3<br>D4<br>D5<br>D8       |
| Essay questions exam       | A final exam on the contents of all the course will be made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 40            | A1                            | B2 | C1 | D1<br>D3<br>D4<br>D5<br>D8       |

## Other comments on the Evaluation

The student has the right to opt for the global assessment according to the procedure and the deadline established by the centre for each call.

The final grade for students with continuous assessment is calculated as follows:

- 20% with a written test at the end of the first part of the subject related to sequences and series
- 30% with a writing at the end of the part related to calculation of a variable
- 10% as a result of practices from the second to the sixth
- 40% with a final exam on the contents of the entire subject

It is required to obtain in the final exam at least 30% of the maximum of the mark of each of the blocks of the subject to pass the exam. In the case of not reaching the aforementioned 30% in any of the parts but the mark obtained from the weighting is greater than or equal to 5 points, the mark that will appear in the minutes will be 4.9 points (failed).

The evaluation system in the second call is the same as in the first call, maintaining the grades obtained for the resolution of problems and/or exercises and class attendance and participation.

Non-attending students to classes and end-of-program call can take an exam in both December and July that covers 100% of the final grade

The dates of the final exams are published on the website of the Escola de Enxeñaría Aeronáutica e do Espazo.

Ethical commitment:

"It is expected is that students present an adequate ethical behavior. If a not appropriate ethical behavior is detected (copying, plagiarism, non authorized use of electronic devices, etc.) the student will not meet the requirements to pass the course. In this case the overall rating in the current academic year will be suspense (0.0). If necessary, a new exam to verify the acquisition of skills and knowledge by the student(s) involved could be performed."

It is recalled the prohibition of the use of mobile devices or laptops in exercises and practices since Real Decreto 1791/2010, of December 30, approving the Statute of University Students, establishes in its article 13.2.d), concerning the duties of university students, the duty to:

*"Refrain from using or cooperating in fraudulent proceedings in the evaluation tests, in the works that are carried out or in official documents of the university".*

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## Sources of information

### Basic Bibliography

J. Burgos, **Cálculo Infinitesimal de una variable**, McGraw-Hill, 2007  
J. Burgos, **Cálculo Infinitesimal de varias variables**, McGraw-Hill, 2008  
R. Larson et al., **Cálculo 1**, McGraw-Hill, 2010  
R. Larson et al., **Cálculo 2**, McGraw-Hill, 2010  
J. Rogawski, **Cálculo. Una variable**, Reverté, 2012  
J. Rogawski, **Cálculo. Varias variables**, Reverté, 2012

### Complementary Bibliography

A. García et al., **Cálculo I**, CLAGSA, 2007  
A. García et al., **Cálculo II**, CLAGSA, 2002

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## Recommendations

### Subjects that continue the syllabus

Physics: Physics II/O07G410V01202  
Mathematics: Calculus II/O07G410V01201  
Aerospace technology/O07G410V01205

### Subjects that are recommended to be taken simultaneously

Physics: Physics I/O07G410V01103  
Computer science/O07G410V01104  
Mathematics: Linear algebra/O07G410V01102

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## Other comments

The tutorial schedule will be published at <https://area.webs.uvigo.es/titorias/> From this page it will be possible to book tutorials.

| IDENTIFYING DATA            |                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| Mathematics: Linear algebra |                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Subject                     | Mathematics:<br>Linear algebra                                                                                                                                                                                                                                                                                                                                               |                 |      |            |
| Code                        | 007G410V01102                                                                                                                                                                                                                                                                                                                                                                |                 |      |            |
| Study programme             | Grado en<br>Ingeniería<br>Aeroespacial                                                                                                                                                                                                                                                                                                                                       |                 |      |            |
| Descriptors                 | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                 | Choose          | Year | Quadmester |
|                             | 6                                                                                                                                                                                                                                                                                                                                                                            | Basic education | 1st  | 1st        |
| Teaching language           | #EnglishFriendly<br>Galician                                                                                                                                                                                                                                                                                                                                                 |                 |      |            |
| Department                  |                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Coordinator                 | García Martínez, Xabier                                                                                                                                                                                                                                                                                                                                                      |                 |      |            |
| Lecturers                   | García Martínez, Xabier                                                                                                                                                                                                                                                                                                                                                      |                 |      |            |
| E-mail                      | xabier.garcia.martinez@uvigo.gal                                                                                                                                                                                                                                                                                                                                             |                 |      |            |
| Web                         | http://aero.uvigo.es/gl/                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| General description         | This subject is part of Mathematics and it is taught in the first semester of the first course. The other subjects of Mathematics are: Calculus I, in the first semester of the first course and Calculus II in the second semester of the first course. Competences of linear algebra are acquired, being a part of them fundamental for the other subjects of Mathematics. |                 |      |            |
|                             | The subject has the character of basic training. It provides the mathematical basis to different disciplines in the field of the aeronautical engineering such as the calculation and manufacture of vehicles and numerical simulation.                                                                                                                                      |                 |      |            |
|                             | 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.                                                                                                                                                                  |                 |      |            |

| Training and Learning Results |                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| Code                          |                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| A1                            | That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study                                                                                    |  |  |  |
| B2                            | Planning, documentation, project management, calculation and manufacturing in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.        |  |  |  |
| C1                            | Capability to solve mathematical problems that may arise in engineering. Aptitude to apply the knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization.                                                                       |  |  |  |
| C32                           | Appropriate knowledge applied to engineering: methods of calculation and development of materials and defence systems; management of experimental techniques, equipment and measuring instruments; numerical simulation of the most significant physical-mathematical processes; inspection, quality control and fault detection techniques; their most appropriate methods and repair techniques. |  |  |  |
| D1                            | Capability of analysis, organization and planification.                                                                                                                                                                                                                                                                                                                                            |  |  |  |
| 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                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| D8                            | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                                                                                                                                |  |  |  |

| Expected results from this subject                                                                    |                               |    |           |                |
|-------------------------------------------------------------------------------------------------------|-------------------------------|----|-----------|----------------|
| Expected results from this subject                                                                    | Training and Learning Results |    |           |                |
| Knowledge and understanding of the main concepts, techniques and numerical methods of Linear Algebra. | A1                            | B2 | C1<br>C32 | D1<br>D3       |
| Ability to apply them to other branches of Mathematics and Engineering Sciences.                      |                               |    |           | D4<br>D5<br>D8 |

| Contents |                                                        |
|----------|--------------------------------------------------------|
| Topic    |                                                        |
| BLOCK I  | 1. Complex numbers.<br>2. Systems of linear equations. |

|           |                                                                  |
|-----------|------------------------------------------------------------------|
| BLOCK II  | 3. Vector spaces.                                                |
| BLOCK III | 4. Linear transformations and matrices.                          |
| BLOCK IV  | 5. Euclidean vector spaces.                                      |
|           | 6. Diagonalisation. Orthogonal transformations.                  |
|           | 7. Numerical methods: resolution of systems of linear equations. |
|           | Computation of eigenvalues.                                      |

## Planning

|                            | Class hours | Hours outside the classroom | Total hours |
|----------------------------|-------------|-----------------------------|-------------|
| Introductory activities    | 1           | 1                           | 2           |
| Lecturing                  | 18          | 37                          | 55          |
| Problem solving            | 27          | 30                          | 57          |
| Autonomous problem solving | 4           | 17                          | 21          |
| Essay questions exam       | 2.5         | 12.5                        | 15          |

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

## Methodologies

|                            | Description                                                                                                                                                   |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Introductory activities    | Activities directed to take contact and gather information on the students, as well as to present the subject.                                                |
| Lecturing                  | Exposition of the contents of the subject. It will be illustrated with numerous examples and applications.                                                    |
| Problem solving            | Approach, analysis, resolution and debate of a problem or exercise related with the subject, given to illustrate and complete the explanation of each lesson. |
| Autonomous problem solving | It will be proposed exercises and problems that the students have to resolve in group by using collaborative learning as a integrated methodology.            |

## Personalized assistance

| Methodologies              | Description                                                                                                                                   |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Introductory activities    | Attention and resolution of doubts to the students in relation to the different activities of the matter.                                     |
| Lecturing                  | Attention and resolution of doubts to the students in relation to the different activities of the matter.                                     |
| Problem solving            | Attention and resolution of doubts to the students in relation to the different activities of the matter.                                     |
| Autonomous problem solving | Attention and resolution of doubts to the students in relation to the different activities of the matter.                                     |
| Tests                      | Description                                                                                                                                   |
| Essay questions exam       | Before the realisation of the exam, attention and resolution of doubts to the students in relation to the different activities of the matter. |

## Assessment

|                            | Description                                                                                                    | Qualification | Training and Learning Results |    |           |                      |
|----------------------------|----------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|-----------|----------------------|
| Autonomous problem solving | Two midterm exams on the content corresponding to the first two units (lectures and problem-solving sessions). | 60            | A1                            | B2 | C1<br>C32 | D3<br>D4<br>D5<br>D8 |
| Essay questions exam       | Final exam that will cover the content from all lectures and problem-solving sessions throughout the course.   | 40            | A1                            | B2 | C1<br>C32 | D3<br>D4<br>D5<br>D8 |
| Duration: 2.5 hours.       |                                                                                                                |               |                               |    |           |                      |

## Other comments on the Evaluation

### CRITERIA OF EVALUATION FOR THE FIRST CALL

Following the continuous assessment method:

If a student does not show to any of the exams, a qualification of 0 will be assigned.

P1: Grade for midterm exam 1;

P2: Grade for midterm exam 2;

F: Grade for final exam.

In the case of achieving at least a 4.5 in the final test, the qualification will be:

$$\max(F, 0.3 \cdot P1 + 0.3 \cdot P2 + 0.4 \cdot F)$$

In the case of not achieving a minimum a 4 in the final test, the qualification will be:

$$\min(4.5, \max(F, 0.3 \cdot P1 + 0.3 \cdot P2 + 0.4 \cdot F))$$

Following the exam-only assessment method:

The final grade will be determined just by the final exam.

The student has the right to opt for the global assessment according to the procedure and the deadline established by the centre for each call. Note that due to the nature of the evaluation formulas, it is not necessary for the student to make any decisions.

### **CRITERIA OF EVALUATION FOR THE SECOND CALL AND END-OF-PROGRAM CALL**

The final mark will be determined by an exam about all the subject.

### **EXAM DATES**

Continuous assessment tests will be carried out during teaching hours.

The calendar of exams officially approved by the centre will be published in the webpage

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

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### **Sources of information**

#### **Basic Bibliography**

González, R., **Álgebra lineal**, 1ª ed, Universidade de Vigo, 2021

Grossman, S. I., **Álgebra lineal**, 7ª, S.A. Mc Graw Hill, 2012

Hernández, E., **Álgebra y Geometría**, 3ª, Addison-Wesley, 2012

Lay, D. C., **Álgebra lineal y sus aplicaciones**, 4ª ed, Pearson, 2012

Merino, L.; Santos, E., **Álgebra Lineal con métodos elementales**, 1ª ed, Paraninfo, 2006

#### **Complementary Bibliography**

Baker, R.; Kuttler, K., **Linear algebra with applications**, 1st ed, World Scientific, 2014

Burgos, Juan de, **Álgebra lineal y geometría cartesiana**, 3ª ed, S.A. Mc Graw Hill, 2006

Castellet, M. ; Llerena, I., **Álgebra Lineal y Geometría**, 1ª ed, Reverté, 1991

Lipschutz, S., **Álgebra Lineal**, 2ª ed, S.A. Mc Graw Hill, 1992

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### **Recommendations**

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| IDENTIFYING DATA    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |      |            |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| Physics: Physics I  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |      |            |
| Subject             | Physics: Physics I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |      |            |
| Code                | 007G410V01103                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |      |            |
| Study programme     | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Descriptors         | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Choose          | Year | Quadmester |
|                     | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Basic education | 1st  | 1st        |
| Teaching language   | #EnglishFriendly<br>Spanish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |      |            |
| Department          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |      |            |
| Coordinator         | Lorenzo Gonzalez, Maria de las Nieves                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |      |            |
| Lecturers           | Cabrera Crespo, Alejandro Jacobo<br>Domínguez Alonso, José Manuel<br>Lorenzo Gonzalez, Maria de las Nieves                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |      |            |
| E-mail              | nlorenzo@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |      |            |
| Web                 | http://aero.uvigo.es/                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |      |            |
| General description | <p>This course will provide the fundamental basis of mechanics, in particular, classical mechanics. Mechanics is the branch of the Physics focused on the study of the behaviour of bodies at rest or moving bodies.</p> <p>During the course of Physics I, the basis of classical mechanics will be studied, which will be extended in the next year in the course of Classical Mechanics.</p> <p>Both basics of the kinematics and the dynamics will be addressed in this Physics I.</p> <p>The kinematics is devoted to study the movement of the bodies, without considering the causes of that movement. That is, the kinematics gives answer to the question of How does a body move?. On the other hand, the dynamics is devoted to study the causes of the movement of the bodies and its evolution. That is, the dynamics, unlike the kinematics, gives answer to the question Why is this body moving?</p> <p>This course is fundamental since the principles of the phenomena related with the behaviour of the bodies (at rest or moving bodies) are based on this course.</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> |                 |      |            |

### Training and Learning Results

|      |                                                                                                                                                                                                                                                                                                                                                                                             |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                                                                                             |
| A1   | That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study                                                                             |
| B2   | Planning, documentation, project management, calculation and manufacturing in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems. |
| C2   | Understanding and mastery of the basic concepts about the general laws of mechanics, thermodynamics, fields and waves and electromagnetism and their application to solve problems related to engineering.                                                                                                                                                                                  |
| D1   | Capability of analysis, organization and planification.                                                                                                                                                                                                                                                                                                                                     |
| 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                                                                                                                                                                                                                                                                                                                                         |

### Expected results from this subject

| Expected results from this subject                                                                                                                                                                                                                                                                                   | Training and Learning Results |    |                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|----------------------|
| Knowledge and understanding of the basic principles of physics and their application to the analysis and resolution of engineering problems.                                                                                                                                                                         | A1                            | C2 | D1<br>D3<br>D5<br>D8 |
| Knowledge, understanding and application of the general laws of the Classical Mechanics, with special upsetting in the relative movements, the cinematic and dynamics of the point, the theorems of the quantity of movement and of the moment kinetical, and the cinematic, static and dynamics of the rigid solid. | B2                            | C2 | D4<br>D5<br>D6       |

### Contents

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

|                                             |                                                                                                                                                                                                                                                                          |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) Basic vectorial Calculus                 | <ul style="list-style-type: none"> <li>- Vectors and scalars</li> <li>- Coordinate system</li> </ul>                                                                                                                                                                     |
| 2) Kinematics                               | <ul style="list-style-type: none"> <li>- Reference system, trajectories, velocity and acceleration</li> <li>- Rectilinear and curvilinear motion</li> <li>- Tangential and normal accelerations</li> </ul>                                                               |
| 3) Relative movement                        | <ul style="list-style-type: none"> <li>- Translation</li> <li>- Rotation</li> <li>- Components of the acceleration</li> </ul>                                                                                                                                            |
| 4) Newton's laws                            | <ul style="list-style-type: none"> <li>- Force</li> <li>- Newton's first law: inertia</li> <li>- Newton's second law: weight</li> <li>- Newton's third law: action-reaction</li> <li>- Linear momentum</li> <li>- Angular momentum</li> <li>- Work and energy</li> </ul> |
| 5) Particle system                          | <ul style="list-style-type: none"> <li>- External and internal forces</li> <li>- Linear impulse. Collisions</li> <li>- Centre of mass.</li> <li>- Linear momentum, angular momentum, work and energy of a particle system</li> </ul>                                     |
| 6) Rigid solids                             | <ul style="list-style-type: none"> <li>- Concept of rig solid. Centre of mass</li> <li>- Moment of inertia</li> <li>- Translation</li> <li>- Rotation around a fixed axis</li> <li>- Rolling motion</li> </ul>                                                           |
| 7) Particle statics and rigid solid statics | <ul style="list-style-type: none"> <li>- General equations of the equilibrium of rigid solid</li> <li>- System of forces</li> <li>- Stability</li> </ul>                                                                                                                 |
| 8) Fluid statics                            | <ul style="list-style-type: none"> <li>- Density and hydrostatic pressure</li> <li>- Archimedes' principle</li> <li>- Surface tension. Capillarity</li> </ul>                                                                                                            |

## Planning

|                                                       | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------------------|-------------|-----------------------------|-------------|
| Lecturing                                             | 32          | 64                          | 96          |
| Autonomous problem solving                            | 3           | 6.5                         | 9.5         |
| Research based methodologies                          | 1           | 4                           | 5           |
| Programmed instruction                                | 0           | 6                           | 6           |
| Laboratory practical                                  | 12          | 0                           | 12          |
| Essay questions exam                                  | 2.5         | 0                           | 2.5         |
| Report of practices, practicum and external practices | 0           | 5                           | 5           |
| Self-assessment                                       | 0           | 12                          | 12          |
| Problem and/or exercise solving                       | 2           | 0                           | 2           |

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

## Methodologies

|                              | Description                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lecturing                    | The theory of the course will be presented and it will be applied to solve problems                                                                                                                                                                     |
| Autonomous problem solving   | The student should solve exercises following some instructions.                                                                                                                                                                                         |
| Research based methodologies | Improves information processing in specific domains by using scientific research activities.                                                                                                                                                            |
| Programmed instruction       | It consists of the presentation of a matter divided into several teaching units, of smaller size, with issues at the end of each teaching unit in order to strengthen the acquired knowledge. These activities can be performed in person or virtually. |
| Laboratory practical         | Tasks related with the contents of the course will be carried out in the laboratory. The realisation of these tasks is mandatory to pass the course                                                                                                     |

## Personalized assistance

| Methodologies                | Description                                                                                                                  |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Laboratory practical         | During the tasks in the laboratory, a personal follow-up will be carried out to guide the students to achieve the objectives |
| Research based methodologies | Tutoring sessions will be scheduled to solve any doubt of the students                                                       |

| Assessment                      |                                                                                                                                                                                                                                                                                                                                                              |               |                               |                               |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|-------------------------------|
|                                 | Description                                                                                                                                                                                                                                                                                                                                                  | Qualification | Training and Learning Results |                               |
| Research based methodologies    | Students will present the results of their research. The maximum marks of this part will be 15% of the final total marks.                                                                                                                                                                                                                                    | 15            |                               | D3<br>D4<br>D6                |
| Laboratory practical            | In order to pass the course, laboratory tasks should be carried out. Continuous assessment will be used during the realisation of the tasks. The maximum marks of this part will be 15% of the final total marks. Duly justified absences will be compensated with other tasks.                                                                              | 15            | A1                            | C2 D1<br>D3<br>D4<br>D6<br>D8 |
| Essay questions exam            | There will be an exam that include questions and exercises. The maximum marks of this part will be 40% of the final total marks. However, a minimum of 5 over 10 has to be reached in the exam to pass the course.                                                                                                                                           | 40            |                               | B2 C2 D4<br>D5                |
| Self-assessment                 | At the end of each topic, students will be able to answer a multiple-choice questionnaire which may account for up to 10% of the final mark.                                                                                                                                                                                                                 | 10            |                               | C2 D6                         |
| Problem and/or exercise solving | In the middle of the syllabus there will be a short evaluation test consisting of solving problems and/or questions. This test can count for up to 20% of the final mark. The mark for the developmental exam may be 4 out of 10 to be averaged with the rest of the marks if the student passes the exercise resolution test with at least 50% of the mark. | 20            |                               | C2 D6                         |

### Other comments on the Evaluation

The second call assessment system is the same as the first call assessment system, maintaining the grades obtained for research-based methodologies, problem solving and/or exercises and practicals.

Assessment dates:

The exam calendar officially approved by the Xunta de Centro is published on the website:

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

The laboratory practicals must have been completed in order to be able to sit the second call exam.

Students who are unable to attend classes must inform the teacher. In this case, the exam will count for 90% of the mark and the practicals for 10%.

In summary:

Out of the 100% of the mark of the subject we have:

- Exam: up to 40%. It is necessary to get a 5 out of 10 in the exam to pass the subject.
- Self-assessment test: up to 10%.
- Laboratory practicals: up to 15%. It is compulsory to pass the internship in order to pass the subject.
- Research work: up to 15%.
- Evaluation test of problems and/or exercises: up to 20%.

Assessment for students who do not opt for continuous assessment.

- Examination/exams: up to 85%, a minimum of 5 out of 10 must be obtained to pass the course.
- Laboratory practicals: up to 15%. It is compulsory to pass the internship in order to pass the subject.

### **VERY IMPORTANT:**

In order to add up all the percentages, the student must get at least 5 out of 10 in the exam grade. In the case of not getting a 5 in the exam, the grade that will appear in the minutes will be the exam grade. The duration of the final exam will be approximately 2.5 hours.

In the event that the student obtains 50% or more of the mark in the evaluation test of problem solving and/or exercises, he/she will have to obtain at least a 4 out of 10 in the exam mark to be able to add up all the percentages. In the case of not achieving a 4 in the exam, the mark that will appear in the minutes will be the exam mark.

Students who fail at the first call and do not attend class may sit the second call exam covering all the content of the

subject, provided that they have completed the laboratory practicals.

In special cases in which, for justified and previously notified reasons, students cannot attend the practicals or take part in the continuous assessment 100% of the mark will correspond to a final exam in which all the competences of the subject will be evaluated.

**Final exam:** students who choose to take the final exam will be assessed only with the exam (which will be worth 100% of the mark). If they do not attend the exam, or do not pass it, they will be assessed in the same way as the rest of the students".

If plagiarism is detected in any of the tests, the final grade will be SUSPENDED (0) and the fact will be communicated to the management of the Centre for the appropriate effects.

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

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## Sources of information

### Basic Bibliography

Sears-Zemansky, **Física Universitaria Volumen I**, 12ª, Addison-Wesley, 2009

Alcaraz i Sendra O., López López J., López Solana Vicente, **Física. Problemas y ejercicios resueltos**, 1ª, Pearson Prentice Hall, 2006

### Complementary Bibliography

Serway R.A., Jewett J.W., **Física para ciencias e ingeniería**, 7ª, Cengage Learning, 2008

Tipler, Paul Allen, **Física**, 5ª, Reverte, 2003

Ferdinand P. Beer ; E. Russell Johnston, Jr. ; Eliot R. Eisenberg, **Mecánica vectorial para ingenieros (Estática)**, 8ª, McGraw-Hill Interamericana, 2007

Ferdinand P. Beer ; E. Russell Johnston, Jr. ; Phillip J. Cornwell, **Mecánica vectorial para ingenieros (Dinámica)**, 9ª, McGraw-Hill Interamericana, 2010

Burbano de Ercilla, Santiago, Burbano García, Enrique y Carlos Gracia Muñoz, **Problemas de Física**, 27ª, Tébar, 2006

Hugh D. Young, Roger A. Freedman, **Sears and Zemansky's university physics : with modern physics**, 13ª, Addison-Wesley, 2012

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## Recommendations

### Subjects that continue the syllabus

Physics: Physics II/O07G410V01202

### Subjects that are recommended to be taken simultaneously

Mathematics: Linear algebra/O07G410V01102

Mathematics: Calculus I/O07G410V01101

| IDENTIFYING DATA    |                                                                                                                                                                                                                                                                                                                                         |                 |      |            |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| Computer science    |                                                                                                                                                                                                                                                                                                                                         |                 |      |            |
| Subject             | Computer science                                                                                                                                                                                                                                                                                                                        |                 |      |            |
| Code                | 007G410V01104                                                                                                                                                                                                                                                                                                                           |                 |      |            |
| Study programme     | Grado en Ingeniería Aeroespacial                                                                                                                                                                                                                                                                                                        |                 |      |            |
| Descriptors         | ECTS Credits                                                                                                                                                                                                                                                                                                                            | Choose          | Year | Quadmester |
|                     | 6                                                                                                                                                                                                                                                                                                                                       | Basic education | 1st  | 1st        |
| Teaching language   | #EnglishFriendly<br>Spanish                                                                                                                                                                                                                                                                                                             |                 |      |            |
| Department          |                                                                                                                                                                                                                                                                                                                                         |                 |      |            |
| Coordinator         | Pérez Pérez, Martín                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| Lecturers           | A0570-Ax2tc-4 A0570-Ax2tc-4, A0570-Ax2tc-4<br>Pérez Pérez, Martín                                                                                                                                                                                                                                                                       |                 |      |            |
| E-mail              | martiperez@uvigo.es                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| Web                 | http://moovi.uvigo.gal                                                                                                                                                                                                                                                                                                                  |                 |      |            |
| General description | In this subject, the basic computer contents and introduction to the programming for graduates in Aerospace Engineering.<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. |                 |      |            |

### Training and Learning Results

|      |                                                                                                                                                                                                                                                                                                                 |  |  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| Code |                                                                                                                                                                                                                                                                                                                 |  |  |
| A1   | That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study |  |  |
| C3   | Basic knowledge about use and programming of computers, operating systems, databases and software with application in engineering.                                                                                                                                                                              |  |  |
| D1   | Capability of analysis, organization and planification.                                                                                                                                                                                                                                                         |  |  |
| 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                                                                                                                                                                                                                                                                      |  |  |
| D8   | Capability for critical and self-critical reasoning                                                                                                                                                                                                                                                             |  |  |
| D9   | Capability to work in interdisciplinary teams                                                                                                                                                                                                                                                                   |  |  |

### Expected results from this subject

| Expected results from this subject                                                                                                                                     | Training and Learning Results |    |                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|----------------------------------------|
| Knowledge, comprehension and application of the basic programming techniques and their use in the resolution of numerical problems in engineering.                     | A1                            | C3 | D4<br>D5<br>D9                         |
| Knowledge, understanding and application of programming methodologies (data and basic operations, modular programming, input-output operations, etc.).                 | A1                            | C3 | D1<br>D2<br>D4<br>D5<br>D6<br>D8<br>D9 |
| Basic knowledge about operating systems and programming languages, mainly oriented to the formulation and implementation of specific numerical methods in engineering. | A1                            | C3 | D1<br>D3<br>D4<br>D5<br>D9             |

### Contents

|                           |                                                                                                                                                           |  |  |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| Topic                     |                                                                                                                                                           |  |  |
| Introduction to computing | Hardware: basic components<br>Basic concepts of software<br>Operating systems<br>Collaborative tools<br>Computer security<br>Computer networks / big data |  |  |

|                                                                    |                                                                                                                |
|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Conceptos de programación básicos                                  | Types of programming languages: low and high level<br>Variables<br>Functions<br>Flow control<br>Input / Output |
| Advanced programming concepts                                      | Advanced data types<br>Exceptions<br>Object-oriented programming                                               |
| Programming being oriented to numerical models used in engineering | Mathematical libraries<br>Parallel calculation<br>Graphical representation                                     |

## Planning

|                         | Class hours | Hours outside the classroom | Total hours |
|-------------------------|-------------|-----------------------------|-------------|
| Introductory activities | 0.5         | 0                           | 0.5         |
| Lecturing               | 23          | 46                          | 69          |
| Practices through ICT   | 20          | 40                          | 60          |
| Laboratory practical    | 4.5         | 5.5                         | 10          |
| Problem solving         | 2           | 6                           | 8           |
| Essay questions exam    | 2.5         | 0                           | 2.5         |

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

## Methodologies

|                         | Description                                                                                                                                                                                                                                                                                   |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Introductory activities | Presentation of the subject: objectives, competences to be acquired by the student, contents, evaluation system. Building of work groups.                                                                                                                                                     |
| Lecturing               | Presentation by the teacher of the contents of the course, theoretical bases and/or guidelines of the works, exercises or projects to be developed by the student.                                                                                                                            |
| Practices through ICT   | Resolution of exercises formulated in the practical sessions, starting with the knowledge as worked in class.                                                                                                                                                                                 |
| Laboratory practical    | Development of programs and documents in which the students reflect the characteristics of their works carried out. The students should describe the tasks and procedures they developed, show the results and observations they carried out, as well as the analysis and processing of data. |
| Problem solving         | Evaluation tests that include theoretical questions or theoretical exercises to solve. The students must respond to the activity formulated and apply the theoretical and practical knowledge of the subject autonomously.                                                                    |

## Personalized assistance

| Methodologies         | Description                                                                                                                                                                                                                                  |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Practices through ICT | The students will have a continuous follow-up and a personalized attention through classes dedicated to the resolution of exercises and the control of the works carried out. They may also attend, if they wish, personalized office hours. |

## Assessment

|                       | Description                                                                                                                                                                                                                                                                                                      | Qualification | Training and Learning Results |    |                                        |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|----------------------------------------|
| Practices through ICT | Attendance and active participation                                                                                                                                                                                                                                                                              | 5             | A1                            | C3 | D3<br>D4<br>D5<br>D8                   |
| Laboratory practical  | Development of programs and documents in which the students reflect the characteristics of their works carried out (none exceeds 40%). The students should describe the tasks and procedures they developed, show the results and observations they carried out, as well as the analysis and processing of data. | 65            | A1                            | C3 | D1<br>D3<br>D4<br>D5<br>D6<br>D8<br>D9 |
| Problem solving       | Evaluation tests that include theoretical questions or theoretical exercises to solve. The students must respond to the activity formulated and apply the theoretical and practical knowledge of the subject autonomously.                                                                                       | 20            | A1                            | C3 | D3<br>D4<br>D5<br>D8                   |

|                      |                                                                                                                                                                                                                            |    |    |    |                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----------------------|
| Essay questions exam | Evaluation tests that include activities and problems or practical exercises to solve. The students must respond to the activity formulated and apply the theoretical and practical knowledge of the subject autonomously. | 10 | A1 | C3 | D3<br>D4<br>D5<br>D8 |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----------------------|

### Other comments on the Evaluation

General remarks:

The student will be able to choose the evaluation system that will be applied to the subject. For this, you must choose, in the first 15 days of the semester, between continuous assessment or exam-only assessment (a single exam at the end of the semester). If you do not specify the type of evaluation desired, it is understood that you opt for continuous evaluation.

The dates and times of the evaluation tests of the different calls are those specified in the evaluation tests calendar approved by the Faculty Board for the 2023-24 academic year.

Continuous assessment tests will be conducted within school hours.

General evaluation criteria:

To pass the subject, the student must obtain, as a final grade, a grade equal to or greater than 5. If in any of the blocks the student obtains a grade lower than 4, even if the average grade is equal to or greater than 5, the subject It will be suspended and the final grade that will appear in the minutes will be Suspense (4).

Evaluation criteria for attendees 1st call:

All students who choose the continuous assessment modality will be evaluated continuously by taking tests and activities, developed throughout the semester, applying the general evaluation criteria described in the previous section.

Evaluation criteria for non-attendees 1st call:

All students who opt for the non-attendance mode will be evaluated with a single final exam (100% of the grade) that will encompass everything seen throughout the semester, applying the general evaluation criteria described above. The student has the right to opt for the global assessment according to the procedure and the deadline established by the centre for each call.

Evaluation criteria for 2nd call and end of degree:

In the second opportunity (July) and in the end-of-degree call, students will be evaluated with a single final exam (100% of the grade) that will encompass all the seen throughout the semester, applying the general evaluation criteria described above. maintaining, if applicable, the qualifications obtained for problem solving, case studies, and / or exercises and attendance and participation.

Evaluated competences: the same as in the evaluation system for assistants. Evaluated learning outcomes: the same as in the evaluation system for assistants.

### Sources of information

#### Basic Bibliography

Bahit, Eugenia, **Curso Python para Principiantes**, Buenos Aires : Safe Creative, 2012

González Duque, Raúl, **Python para todos**, Creative Commons, 2008

Summerfield, Mark, **Python 3**, Anaya, 2009

Guttag, John V., **Introduction to computation and programming using Python**, MIT Press, 2013

#### Complementary Bibliography

### Recommendations

### Other comments

#### RECOMMENDATIONS

Guidelines for the study:

- Attend classes.
- Do the exercises in the practices.
- Review the bibliography and resources presented in class.

Proposals for improvement and recovery:

- Students who have problems in following the pace of learning of the subject should attend the tutorials with the teachers and extend the time dedicated to independent and autonomous learning.
-

| IDENTIFYING DATA                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| <b>Expresión gráfica: Expresión gráfica</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| Subject                                     | Expresión gráfica:<br>Expresión gráfica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |      |            |
| Code                                        | O07G410V01105                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |      |            |
| Study programme                             | Grao en Enxeñaría Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |      |            |
| Descriptors                                 | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Choose          | Year | Quadmester |
|                                             | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Basic education | 1    | 1c         |
| Teaching language                           | Galego                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Department                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| Coordinator                                 | Riol Cañedo, José Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |      |            |
| Lecturers                                   | Iglesias Sánchez, Iván<br>Riol Cañedo, José Carlos                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |      |            |
| E-mail                                      | jriol@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |      |            |
| Web                                         | <a href="http://aero.uvigo.es/gl/">http://aero.uvigo.es/gl/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| General description                         | <p>O principal obxectivo da materia é capacitar o estudantado para a xestión e utilización dos sistemas e técnicas de representación máis utilizados pola industria aeroespacial, que están baseados na xeometría, sexa esta: métrica, proxectiva, analítica, descritiva ou computacional.</p> <p>O coñecemento dos métodos para a creación de formas, as súas propiedades e o seu manexo nos diversos contextos de enxeñaría, tanto no plano como no espazo 3D, require unha capacidade axeitada para a análise, a síntese e a visualización (abstracción e idealización), así como do uso da linguaxe gráfica.</p> <p>A normalización, necesaria para unha definición exhaustiva de formas, compoñentes, obxectos, equipos ou instalacións nos proxectos, require do coñecemento das normas básicas sobre formatos, liñas, modos de representación, dimensionamento, símbolos ou especificacións xeométricas do produto (GPS) .</p> <p>O manexo dalgunha aplicación gráfica actual que facilite a creación en 3D e a conseguinte produción de vistas, a montaxe de compoñentes, a simulación e o movemento, a interactividade entre diferentes arquivos ou o dimensionamento paramétrico, enche este enfoque.</p> |                 |      |            |

### Resultados de Formación e Aprendizaxe

|      |                                                                                                                                                                                                                                                                                                                               |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                               |
| A1   | Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo |
| C5   | Capacidade de visión espacial e coñecemento das técnicas de representación gráfica, tanto por métodos tradicionais de xeometría métrica e xeometría descritiva, como mediante as aplicacións de deseño asistido por computador.                                                                                               |
| D1   | Capacidade de análise, organización e planificación                                                                                                                                                                                                                                                                           |
| 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 interpersonal                                                                                                                                                                                                                                                                                      |
| D8   | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                |

### Resultados previstos na materia

| Expected results from this subject                                                                                                                                 | Training and Learning Results |    |                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|----------------------|
| Desenvolvemento da capacidade de análise e interpretación gráfica de enunciados, propiedades e situacións de diversa índole prantexados en contextos de enxeñaría. | A1                            | C5 | D1<br>D3<br>D5<br>D6 |
| Desenvolvemento da capacidade de abstracción e idealización.                                                                                                       | A1                            | C5 | D1<br>D4<br>D8       |
| Coñecemento dos principios xerais sobre deseño xeométrico.                                                                                                         |                               | C5 | D1<br>D3<br>D6<br>D8 |
| Coñecemento das principais ferramentas e técnicas de representación.                                                                                               | A1                            | C5 | D4<br>D6<br>D8       |

### Contidos

|        |   |
|--------|---|
| Topic  |   |
| TEORÍA | . |

|                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1- Introducción á Normalización                                            | <p>1.1-Gráficos na Enxeñaría para a visualización de datos, a comunicación e a definición formal dos obxectos.</p> <p>1.2-Linguaxe gráfica e Normalización. Organismos para a normalización.</p> <p>1.4-Normas básicas para a elaboración de planos: formatos, escalas, liñas, vistas e anotacións.</p> <p>1.5-Principios xerais de representación. Elección de vistas e cortes. Normativa.</p> <p>1.6-Sistemas europeo e americano. Adaptación aos sistemas CAD.</p>                                                                                                |
| 2- Curvas planas e as súas aplicacións.                                    | <p>2.1-Cónicas: propiedades, trazados e aplicacións.</p> <p>2.2-Estudo proxectivo das cónicas</p> <p>2.3-Curvas de rodadura. Aplicacións.</p> <p>2.4-Outras curvas: espirais, envolventes, evolutas, etc. Aplicacións.</p> <p>2.5-Aproximacións poligonais a unha curva plana.</p> <p>2.6-Curvas alabeadas. Triedro intrínseco. A hélice.</p>                                                                                                                                                                                                                        |
| 3- Fundamentos e Técnicas dos Sistemas de Representación.                  | <p>3.1-Fundamentos proxectivos dos sistemas de representación. Tipos de proxección.</p> <p>3.2-Paso dun sistema a outro.</p> <p>3.3-Pares, ternas e cuaternas. Invariantes proxectivos.</p> <p>3.4-Formas proxectivas. Categorías.</p> <p>3.5-Homoloxía e afinidade.</p> <p>3.6-Sistema diédrico: operacións básicas, medida de ángulos e distancias. Interseccións.</p> <p>3.7-Sistema axonométrico directo e indirecto. Tipos de axonometría. Proxección oblicua.</p> <p>3.8-Sistema de planos acoutados. Aplicacións: topografía, cubertas, trazado de viais.</p> |
| 4- Visualización e representación de formas corpóreas.                     | <p>4.1-Representación de corpos nos diversos sistemas de representación.</p> <p>4.2-Operacións específicas para a obtención de vistas nunha determinada dirección, partes vistas e ocultas, interseccións.</p> <p>4.3- Determinación de verdadeiras magnitudes mediante xiros, abatements e cambios de plano.</p>                                                                                                                                                                                                                                                    |
| 5- Superficies regradas e as súas aplicacións                              | <p>5.1-Clasificación xeral das superficies.</p> <p>5.2-Superficies regradas: desenvolvibles e alabeadas. Aplicacións.</p> <p>5.3-Superficies curvas. A esfera. Geodesia.</p> <p>5.4-As cuádras. Aplicacións.</p> <p>5.5-Interseccións entre superficies.</p> <p>5.6-Superficies poliédricas. Tipos, características, elementos de simetría e representación.</p> <p>5.7-Agrupamento de poliedros e compartimentación do espazo.</p>                                                                                                                                  |
| 6- Elementos e Formas de Acotación                                         | <p>6.1-Acotación. Elementos básicos.</p> <p>6.2-Principios xerais de acotación. Sistemas de referencia.</p> <p>6.3-Elementos roscados.</p> <p>6.4-Tipos de acotación. Criterios.</p> <p>6.5-Normativa básica.</p> <p>6.6-Acotación funcional.</p> <p>6.7-Tolerancias dimensionais. Axustes. Casos.</p> <p>6.8-Tolerancias xeométricas. Especificacións nos debuxos.</p> <p>6.9-Acabados superficiais. Especificacións.</p>                                                                                                                                           |
| 7- Representación de Elementos Normalizados e Conxuntos                    | <p>7.1-Representación e utilización de compoñentes normalizados nos mecanismos. Elementos de unión. Elementos de transmisión. Outros.</p> <p>7.2-Debuxos de conxunto. Características.</p> <p>7.3-Especificacións nos debuxos de conxunto.</p> <p>7.4-Lista de pezas.</p> <p>7.5-O ensamblado 3D no ordenador, establecemento de relacións entre compoñentes, animacións, estudos de movemento e simulacións.</p>                                                                                                                                                    |
| 8- Fundamentos de simboloxía e representacións esquemáticas para Enxeñaría | <p>8.1-Simboloxía en Enxeñaría. Iconicidade.</p> <p>8.2-Representacións esquemáticas.</p> <p>8.3-Aplicacións: mecánica, electricidade e electrónica.</p> <p>8.4-Normas.</p>                                                                                                                                                                                                                                                                                                                                                                                          |
| PRÁCTICAS.                                                                 | .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## 1- DESEÑO ASISTIDO POR ORDENADOR

Presentación do programa por parte do profesor o primeiro día. Descrición das principais características e posibilidades da ferramenta. Exercicios orientados ao adestramento e a familiarización cos comandos e funcións fundamentais. Procederase a xeración directa de modelos 3D da que derivarán as vistas e cortes necesarios para a súa definición normalizada en 2D. Finalmente efectúase o ensamblado de compoñentes coas restriccións apropiadas que permiten a animación dos mesmos e a simulación. Ao longo do curso utilizaranse os distintos tipos de cotas (condutoras, conducidas, dependentes de unha ecuación matemática ou dun parámetro, vinculadas, etc.).

## 2- PRÁCTICAS ORDINARIAS

Comezase cun repaso das construcións xeométricas básicas, realizado á man, que necesariamente require de traballo na casa. Cada parte teórica será complementada con exercicios a realizar durante as horas de práctica, nas sucesivas semanas, que o discente debe completar na casa. En paralelo realízase o adestramento na aplicación e íranse resolvendo exercicios no computador de modo que se capacite ao estudiantado para elaborar o traballo final no ordenador.

## 3- TRABALLO PRÁCTICO (TrP)

Propónse a realización dun traballo práctico (TrP) a realizar durante todo o curso, en grupos de 1-3 alumnos, a modo de pequeno proxecto relacionado con mecanismos habituais do entorno da aeronáutica (conxunto, subconxunto ou grupo de compoñentes que desempeñen algunha función relacionada coa temática aeroespacial), no que se refire á súa definición gráfica. A complexidade pode variar segundo a elección de cada grupo.

### Planificación

|                                           | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------|-------------|-----------------------------|-------------|
| Actividades introductorias                | 0           | 2                           | 2           |
| Lección maxistral                         | 26          | 50                          | 76          |
| Prácticas con apoio das TIC               | 24          | 36                          | 60          |
| Seminario                                 | 0           | 2                           | 2           |
| Resolución de problemas de forma autónoma | 0           | 7.5                         | 7.5         |
| Exame de preguntas de desenvolvemento     | 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                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Actividades introductorias                | Presentación da materia na data establecida polo Centro. Aspectos a repasar e refrescar sobre conceptos fundamentais e construcións xeométricas básicas, a realizar na casa a primeira semana do curso.                                                                                                                                             |
| Lección maxistral                         | Sesión maxistral activa na que cada unidade temática será presentada polo profesor e complementada cos comentarios dos estudantes, baseados na bibliografía xeral que se facilita e noutra específica que se poda engadir para cada tema particular.                                                                                                |
| Prácticas con apoio das TIC               | As prácticas presenciais completaranse con exercicios a resolver na casa, de maneira individual ou colectiva, á man e/ou con ordenador, orientados á aplicación da teoría e a acadar destreza tanto na utilización das ferramentas tradicionais como automatizadas o que implica a utilización das TICs. Habilitarase un espazo a tal fin en moovi. |
| Seminario                                 | Para orientación e seguimento do traballo práctico, formación de grupos e resolución de dúbidas.                                                                                                                                                                                                                                                    |
| Resolución de problemas de forma autónoma | Exercicios curtos, prantexados semanalmente, a resolver polo alumno na casa; así como un traballo a desenvolver durante o curso para entregar ó remate, consistente na creación dos compoñentes e ensamblado dos mesmos para configurar o mecanismo.                                                                                                |

### Atención personalizada

| Methodologies              | Description                                                                                                                                       |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Seminario                  | Selección do traballo a desenvolver, coa guía do profesor                                                                                         |
| Actividades introductorias | Repaso de cuestións básicas, incluso con algunha clase presencial extra, voluntaria, para os que non cursaran as materias previas no bacharelato. |

### Avaliación

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

|                                           |                                                                                                                                                   |    |    |    |                            |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----------------------------|
| Lección maxistral                         | Exame ordinario con preguntas de desenvolvemento de teoría e exercicios prácticos, sobre dos contidos tratados nas distintas sesións, a realizar: | 60 | A1 | C5 | D1<br>D3<br>D4<br>D6<br>D8 |
|                                           | 1º parcial en torno á semana 7ª (30%).                                                                                                            |    |    |    |                            |
|                                           | Examen final na data establecida polo centro, que comprende: 2º parcial (30%), máis a recuperación ou mellora do 1º parcial.                      |    |    |    |                            |
| Prácticas con apoio das TIC               | Avaliación das prácticas realizadas semanalmente, que se completan na casa. Publicaranse informes periódicos coas calificacións obtidas.          | 30 | A1 | C5 | D1<br>D4<br>D6             |
| Resolución de problemas de forma autónoma | Avaliación dun traballo realizado durante o curso, consistente no deseño de compoñentes, ensamblado dos mesmos e simulación do mecanismo.         | 10 |    | C5 | D1<br>D3<br>D4<br>D5<br>D8 |

### Other comments on the Evaluation

A avaliación continua incluírá todo o traballo desenvolvido de modo presencial ou non presencial, daquelas actividades individuais e grupais programadas. A asignatura supérase mediante a avaliación continua ao acadar 5,00 puntos en cada unha das 3 partes en que se divide. No caso de non acadar 5,00 en cada parte, a materia tamén pode superarse se en cada parte se supera o 4,5 e a media resulta igual ou superior a 5,00 puntos. No caso de que a media sexa igual ou superior a 5 pero non se chegue ao 4,5 nalguna das partes, a nota que figurará en acta será 4,9.

A mediados do curso (semana 7ª) realizarase un exame parcial (30% da nota total). A cualificación desta primeira parte será a obtida nese exame parcial ou ben na súa recuperación no exame final. O exame final, na data fixada polo centro, constará de dúas partes: a recuperación do primeiro parcial máis o exame do segundo parcial. A cualificación do segundo parcial será a obtida no exame final desta parte (30% da nota total). O 40% restante da nota total, segundo a metodoloxía anteriormente esposta, obterase polas prácticas e traballos realizados durante o curso nas porcentaxes indicadas.

No caso de non seguir o proceso de avaliación continua o/a estudante poderá presentarse ao exame final da materia, podendo neste caso completarse dito exame co exame das prácticas. A súa cualificación será a obtida en dito exame.

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

Para a avaliación da segunda oportunidade manteranse as cualificacións das partes superadas anteriormente, debendo recuperarse as non superadas e podendo presentarse tamén ás superadas co obxectivo de mellorar a cualificación final.

Datas avaliación: Segundo o calendario de exames aprobado oficialmente pola Xunta da Escola, que se publica na súa páxina web: <http://aero.uvigo.es/gl/docencia/exames>. A parte práctica, de ser o caso, podería requirir algún tipo de prova ó marxe de tales datas.

Compromiso ético: "Espérase que o estudiantado presente un comportamento ético axeitado. En caso de detectar un comportamento ético non axeitado (copia, plaxio, utilización de aparellos electrónicos non autorizados, e outros) considerarase que o/a alumno/a non reúne os requisitos necesarios para superar a materia. Neste caso a cualificación global no presente curso académico será de suspenso (0.0). No caso de ser necesario, poderase realizar un novo exame para verificar a adquisición de competencias e coñecementos por parte do alumnado implicado."

### Bibliografía. Fontes de información

#### Basic Bibliography

AENOR, **Normas varias, actualizadas**, Segundo cada norma, Biblioteca/Norweb,  
Félez Mindán, J., **Ingeniería Gráfica y Diseño**, Síntesis D.L., 2008  
Izquierdo Asensi, F., **Geometría Descriptiva Superior y Aplicada**, 6ª, Ed. Dossat, 2013  
Prieto Alberca, M., **Fundamentos Geométricos del Diseño en Ingeniería**, ADI, 1992

#### Complementary Bibliography

Félez Mindán, J., **Dibujo Industrial**, 3ª, Ed. Síntesis, 2000  
Izquierdo Asensi, F., **Geometría Descriptiva**, 24ª, Ed. Paraninfo, 2000  
Prieto Alberca, M., **Geometría Aplicada al Diseño**, ADI, 2010  
Company, P.; Vergara, M; Mondragón, S., **Dibujo Industrial**, Universitat Jaume I, 2007

### Recomendacións

#### Subjects that continue the syllabus

**Other comments**

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A conveniencia de:

- 1) ter cursado as materias de "Debuxo Técnico" no bacharelato de Ciencias e Tecnolóxico como parte introductoria, para facilitar o proceso de aprendizaxe;
  - 2) ter utilizado programas CAD en cursos previos.
-

| IDENTIFYING DATA         |                                                                                                                                                                                                                                                                                    |                 |      |            |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| Mathematics: Calculus II |                                                                                                                                                                                                                                                                                    |                 |      |            |
| Subject                  | Mathematics:<br>Calculus II                                                                                                                                                                                                                                                        |                 |      |            |
| Code                     | 007G410V01201                                                                                                                                                                                                                                                                      |                 |      |            |
| Study programme          | Grado en<br>Ingeniería<br>Aeroespacial                                                                                                                                                                                                                                             |                 |      |            |
| Descriptors              | ECTS Credits                                                                                                                                                                                                                                                                       | Choose          | Year | Quadmester |
|                          | 6                                                                                                                                                                                                                                                                                  | Basic education | 1st  | 2nd        |
| Teaching language        | #EnglishFriendly<br>Galician                                                                                                                                                                                                                                                       |                 |      |            |
| Department               |                                                                                                                                                                                                                                                                                    |                 |      |            |
| Coordinator              | Cid Iglesias, María Begoña                                                                                                                                                                                                                                                         |                 |      |            |
| Lecturers                | Cid Iglesias, María Begoña                                                                                                                                                                                                                                                         |                 |      |            |
| E-mail                   | bego@dma.uvigo.es                                                                                                                                                                                                                                                                  |                 |      |            |
| Web                      | <a href="http://aero.uvigo.es/gl/">http://aero.uvigo.es/gl/</a>                                                                                                                                                                                                                    |                 |      |            |
| General description      | The objective of the subject is that the students know and dominate the basic techniques of the integral calculus, vector calculus, ordinary differential equations and their applications, necessary both for other subjects of the qualifications and the professional exercise. |                 |      |            |
|                          | 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.                                                                                                                                                                                                                                               |                 |      |            |

### Training and Learning Results

|      |                                                                                                                                                                                                                                                                                                                                                                                                    |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                                                                                                    |
| A1   | That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study                                                                                    |
| B2   | Planning, documentation, project management, calculation and manufacturing in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems.        |
| C1   | Capability to solve mathematical problems that may arise in engineering. Aptitude to apply the knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization.                                                                       |
| C32  | Appropriate knowledge applied to engineering: methods of calculation and development of materials and defence systems; management of experimental techniques, equipment and measuring instruments; numerical simulation of the most significant physical-mathematical processes; inspection, quality control and fault detection techniques; their most appropriate methods and repair techniques. |
| D1   | Capability of analysis, organization and planification.                                                                                                                                                                                                                                                                                                                                            |
| 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   | Capabiliity for interpersonal communication                                                                                                                                                                                                                                                                                                                                                        |
| D8   | Capabiliity for critical and self-critical reasoning                                                                                                                                                                                                                                                                                                                                               |

### Expected results from this subject

| Expected results from this subject                                                                                                                  | Training and Learning Results |    |           |                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|-----------|----------------------------------|
| Knowledge and understanding of the main concepts and techniques of the integral calculus in several variables.                                      | A1                            | B2 | C1<br>C32 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |
| Knowledge and understanding of the models that adopt the form of ordinary differential equations and the main elementary techniques of integration. | A1                            | B2 | C1<br>C32 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |

|                                                                                                                                                                                                                                                                         |    |    |           |                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|-----------|----------------------------------|
| Knowledge, understanding and application of the numerical methods of resolution of the models and typical problems of the aerospace technology; in concrete, polynomial interpolation, numerical differentiation and the resolution of ordinary differential equations. | A1 | B2 | C1<br>C32 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|-----------|----------------------------------|

## Contents

| Topic                                                                          |                                                                                |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Multiple integrals. Fubini's theorem. Change of variable.                      | Multiple integrals. Fubini's theorem. Change of variable.                      |
| Line and surface integrals.                                                    | Line and surface integrals.                                                    |
| Gauss' and Stokes' theorems                                                    | Gauss' and Stokes' theorems                                                    |
| Introduction to the ordinary differential equations. Existence and uniqueness. | Introduction to the ordinary differential equations. Existence and uniqueness. |
| Linear systems and systems with constant coefficients.                         | Linear systems and systems with constant coefficients.                         |
| Numerical resolution of ordinary differential equations.                       | Numerical resolution of ordinary differential equations.                       |
| Polynomial interpolation.                                                      | Polynomial interpolation.                                                      |

## Planning

|                            | Class hours | Hours outside the classroom | Total hours |
|----------------------------|-------------|-----------------------------|-------------|
| Introductory activities    | 1           | 1                           | 2           |
| Lecturing                  | 28          | 56                          | 84          |
| Problem solving            | 15          | 15                          | 30          |
| Autonomous problem solving | 0           | 13.5                        | 13.5        |
| Practices through ICT      | 6           | 12                          | 18          |
| Essay questions exam       | 2.5         | 0                           | 2.5         |

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

## Methodologies

|                            | Description                                                                                                                                               |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Introductory activities    | Activities to make contact and gather information on the students, and to present the subject.                                                            |
| Lecturing                  | The professor will present in the theoretical classes the contents of the subject. Students will have basic reference texts for tracking the subject.     |
| Problem solving            | The professor will solve problems and exercises manually and the student will have to solve similar exercises to acquire the necessary skills.            |
| Autonomous problem solving | The students will have to solve exercises independently to check the acquisition of the skills.                                                           |
| Practices through ICT      | The professor will solve problems and exercises with computer tools and the student will have to solve similar exercises to acquire the necessary skills. |

## Personalized assistance

| Methodologies              | Description                                                                                                                                                                                                                             |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lecturing                  | The professor will personally solve the doubts of students. The doubts will be solved in-person, specially during problems and laboratory lectures and during tutorials, and also by using the remote options available for the course. |
| Problem solving            | The professor will personally solve the doubts of students. The doubts will be solved in-person, specially during problems and laboratory lectures and during tutorials, and also by using the remote options available for the course. |
| Autonomous problem solving | The professor will personally solve the doubts of students. The doubts will be solved in-person, specially during problems and laboratory lectures and during tutorials, and also by using the remote options available for the course. |

## Assessment

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

|                            |                                                                                                                                                                                                                |    |    |    |           |                                  |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|-----------|----------------------------------|
| Autonomous problem solving | There will be a written test for each of the parts of the subject in order to evaluate the resolution of exercises and/or problems in an autonomous way. Each test will have a weight of 25%.<br>RA1, RA2, RA3 | 50 | A1 | B2 | C1<br>C32 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |
| Practices through ICT      | Attendance and correct completion of the practical exercises using computer programmes.<br>RA3                                                                                                                 | 10 |    |    | C1        | D1<br>D4<br>D5<br>D8             |
| Essay questions exam       | Completion of a final exam in which the contents corresponding to the master sessions and problem solving are collected.<br>RA1, RA2                                                                           | 40 | A1 | B2 | C1<br>C32 | D1<br>D3<br>D4<br>D5<br>D8       |

### Other comments on the Evaluation

The preferred mode of assessment is continuous assessment. The student has the right to opt for the overall assessment (100% of the grade on the official date) according to the procedure and deadline established by the centre for each call.

In any call it is necessary to obtain 5 points to pass the subject. The maximum duration of any exam will be 3 hours. Since the subject has two distinct parts, it will be necessary to have a minimum of 2 points out of 5 in each part. In the case of obtaining a grade lower than 2 points in any of the parts, the final grade that will appear in the certificate will be the sum of both notes limiting it to a maximum of 4.8 points. (\*)

### Second call evaluation:

An exam in which the learning outcomes and the attainment of the competences indicated in the teaching guide will be assessed. indicated in the teaching guide. The exam will provide 90% of the grade. In case of having obtained a minimum of 3 points in one part (and not having obtained 2 points in the other part), the student can choose to take only the failed part or the whole exam. The criterion indicated in (\*) will also apply.

The student may choose to maintain the grade obtained in the continuous assessment of the practical part or to take a specific test again to complete the practical part of the exam. again a specific test to complete the remaining 10% of the grade.

### Exam-only assesment procedure (any call):

An examination will be carried out to assess the learning outcomes and the achievement of the competences indicated in the teacher's guide. This exam will provide 100% of the rating of this call. The criterion indicated in (\*) will also apply.

### Evaluation dates:

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

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

It remembers the prohibition of the use of mobile devices or portable computers in exercises and practical since the Royal decree 1791/2010, of 30 December, by which approves the Statute of the University Student, establishes in his article 13.2.d), relative to the duties of the university students, the duty of :

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

### Sources of information

#### Basic Bibliography

E. Marsden, A.J. Tromba, **Cálculo Vectorial**, Pearson, 2004

R. Larson, B.H. Edwards, **Cálculo 2 de varias variables**, 10ª, McGraw-Hill, 2016

G.F. Simmons, **Ecuaciones Diferenciales con aplicaciones y notas históricas**, McGraw-Hill, 1993

#### Complementary Bibliography

A. García et al., **Cálculo II**, CLAGSA, 2002

D.G. Zill, **Ecuaciones diferenciales con aplicaciones de modelado**, 9ª, International Thomson Edit., 2009

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**Recommendations****Subjects that continue the syllabus**

Mathematics: Mathematical methods/O07G410V01301

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

Physics: Physics II/O07G410V01202

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

Physics: Physics I/O07G410V01103

Mathematics: Linear algebra/O07G410V01102

Mathematics: Calculus I/O07G410V01101

**Other comments**

It is recommended attend to class and work the contents weekly.

| IDENTIFYING DATA    |                                                                                                                                                                                                             |                 |      |            |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| Physics: Physics II |                                                                                                                                                                                                             |                 |      |            |
| Subject             | Physics: Physics II                                                                                                                                                                                         |                 |      |            |
| Code                | 007G410V01202                                                                                                                                                                                               |                 |      |            |
| Study programme     | Grado en Ingeniería Aeroespacial                                                                                                                                                                            |                 |      |            |
| Descriptors         | ECTS Credits                                                                                                                                                                                                | Choose          | Year | Quadmester |
|                     | 6                                                                                                                                                                                                           | Basic education | 1st  | 2nd        |
| Teaching language   | #EnglishFriendly<br>Spanish<br>Galician                                                                                                                                                                     |                 |      |            |
| Department          |                                                                                                                                                                                                             |                 |      |            |
| Coordinator         | Salgueiro Piñeiro, Jose Ramon                                                                                                                                                                               |                 |      |            |
| Lecturers           | Cerdeiriña Álvarez, Claudio<br>Michinel Álvarez, Humberto Javier<br>Salgueiro Piñeiro, Jose Ramon                                                                                                           |                 |      |            |
| E-mail              | jrs@uvigo.es                                                                                                                                                                                                |                 |      |            |
| Web                 | http://aero.uvigo.es                                                                                                                                                                                        |                 |      |            |
| General description | The matter of Physics II is fundamentally oriented to provide the training and basic competences on the basic electromagnetism, including its main theoretical practical aspects.                           |                 |      |            |
|                     | 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. |                 |      |            |

### Training and Learning Results

|      |                                                                                                                                                                                                                                                                                                                                                                                             |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                                                                                             |
| A1   | That the students demonstrate to possess and understand knowledge in an area of study that is part of the general education (second level), and often found at a level that, although based on advanced textbooks, also includes some aspects that involve knowledge from the avant-garde of the field of study                                                                             |
| B2   | Planning, documentation, project management, calculation and manufacturing in the field of aeronautical engineering (in accordance with what is established in section 5 of order CIN / 308/2009), aerospace vehicles, propulsion systems, aerospace materials, airport infrastructures, air navigation infrastructures and space management, air traffic and transport management systems. |
| C2   | Understanding and mastery of the basic concepts about the general laws of mechanics, thermodynamics, fields and waves and electromagnetism and their application to solve problems related to engineering.                                                                                                                                                                                  |
| D1   | Capability of analysis, organization and planification.                                                                                                                                                                                                                                                                                                                                     |
| 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   | Capabiliity for interpersonal communication                                                                                                                                                                                                                                                                                                                                                 |
| D8   | Capabiliity for critical and self-critical reasoning                                                                                                                                                                                                                                                                                                                                        |

### Expected results from this subject

| Expected results from this subject                                                                                                                                                              | Training and Learning Results |    |    |                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----|----|----------------------------------|
| Knowledge and understanding of the basic principles of Physics and their application to the analysis and to the resolution of problems in engineering                                           | A1                            | B2 | C2 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |
| Knowledge, understanding and application of the principles of electromagnetism, including telectrostatics, magnetostatics and Maxwell's equations.                                              | A1                            |    | C2 | D5<br>D8                         |
| Knowledge, understanding and application of the general laws of classical Thermodynamics, introducing the concept of thermodynamic equilibrium and the most important thermodynamic magnitudes. | A1                            |    | C2 | D5<br>D8                         |

### Contents

|                                                        |                                                                                                                                                                                                      |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                  |                                                                                                                                                                                                      |
| Presentation of the course and historical introduction | Historical introduction.                                                                                                                                                                             |
| Scalar and vector fields                               | Coordinate systems in two and three dimensions. Field concept. Vectorial operators. Gradient of a scalar. Circulation of a vector. Flow. Divergence. Divergence theorem. Rotational. Stokes theorem. |

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Electrostatics                            | Charge and charge density. Coulomb's law. Electrostatic field. Flow of the electrostatic field. Gauss' Law. Electrostatic potential. Poisson and Laplace equations. Electrostatic field energy. Potential multipole expansion. Dipoles. Conductors and dielectrics. Electrostatics in presence of matter. Capacitors.                                                                                                                                                    |
| Electrical currents and magnetostatics    | Current and current density. Continuity equation. Ohm's law. Conductivity and resistivity. Introduction to the magnetic field. Force between currents. Magnetic induction. Lorentz's force. Biot and Savart's law. Magnetic flux. Ampère's circuital law. Vector potential. Multipolar expansion of vector potential. Magnetic dipoles. Magnetic dipolar moment. Magnetism in presence of matter. Magnetic response of the materials. Magnetic field. Hysteresis cycles. |
| Electrical circuits                       | Combination of resistors. Electromotive force. Electrical circuits. Electric power and energy. Voltage and current sources. Measurement of voltages, currents and resistors. Kirchhoff's laws and circuit analysis. Thévenin and Norton theorems.                                                                                                                                                                                                                        |
| Introduction to Electrodynamics           | Faraday's induction law. Inductance. Generators, motors and transformers. Magnetic energy. Displacement current. Maxwell's equations. Energy and momentum of the electromagnetic field.                                                                                                                                                                                                                                                                                  |
| Alternating current                       | Capacitive and inductive reactances. Impedance. Mean and effective power. Complex magnitudes. RLC series and parallel circuits. Resonance. Quality factor. Apparent and reactive power. Transitory states.                                                                                                                                                                                                                                                               |
| Introduction to electromagnetic waves     | Types of waves. Energy carried by a wave. Huygens' principle. Superposition of waves of different frequency. Phase and group velocities. Electromagnetic wave equation. Hertz's experiment. Electromagnetic spectrum. Propagation of electromagnetic waves. Electromagnetic energy. Radiometric magnitudes and units. Polarization. Reflection and refraction. Interference and diffraction.                                                                             |
| Introduction to thermodynamics. Law zero. | Historical introduction. Fundamental concepts. Thermal equilibrium. Temperature. Temperature measurement: thermometric scales. Types of thermometers.                                                                                                                                                                                                                                                                                                                    |
| First law of thermodynamics               | Work. Heat concept. Internal energy. Heat capacity. Latent heat.                                                                                                                                                                                                                                                                                                                                                                                                         |
| Second law of thermodynamics              | Thermal and freezing machines. Second law statements. Carnot's cycle. Carnot's theorem. Thermodynamic scale of temperatures. Entropy. Entropy increase principle. Third law of thermodynamics. Fundamental equations and state equations.                                                                                                                                                                                                                                |
| Ideal gases                               | Definition of an ideal gas. Status equation. Joule's experiment. Mayer's law. Isocoric, isobaric, isothermic and adiabatic processes for an ideal gas. Slope of isotherms and adiabats.                                                                                                                                                                                                                                                                                  |
| Laboratory experiences                    | Measurement of basic electromagnetic properties with multimeter and oscilloscope. Measurement of the capacity of a capacitor. Measurement of Laplace's force. Helmholtz coils. Measurement of the terrestrial magnetic field. Magnetic dipole. Electromagnetic induction. Circuits. Ideal gas state equation.                                                                                                                                                            |

## Planning

|                                                       | Class hours | Hours outside the classroom | Total hours |
|-------------------------------------------------------|-------------|-----------------------------|-------------|
| Lecturing                                             | 20          | 40                          | 60          |
| Laboratory practical                                  | 12          | 18                          | 30          |
| Problem solving                                       | 7           | 10.5                        | 17.5        |
| Introductory activities                               | 1           | 0                           | 1           |
| Seminars                                              | 10          | 15                          | 25          |
| Essay questions exam                                  | 2.5         | 0                           | 2.5         |
| Report of practices, practicum and external practices | 0           | 14                          | 14          |

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

## Methodologies

|                         | Description                                                                                                                               |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Lecturing               | Classes one hour long to exposed the main theoretical concepts of the matter.                                                             |
| Laboratory practical    | Development of experiments in laboratory to illustrate the main theoretical concepts previously developed on the lectures.                |
| Problem solving         | Resolution of selected exercises similar to those the student will face later in an autonomous way.                                       |
| Introductory activities | Presentation of the subject and lecturers. Presentation of the laboratory.                                                                |
| Seminars                | Approach, discussion and resolution of questions and problems in relation with the theoretical concepts previously developed in lectures. |

| <b>Personalized assistance</b> |                                                                                                                                                           |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Methodologies</b>           | <b>Description</b>                                                                                                                                        |
| Laboratory practical           | The lecturer individually explains the development of the experiments to be carried out at the laboratory.                                                |
| Lecturing                      | The lecturer individually supervises the correct assimilation of the theoretical concepts developed in the lectures.                                      |
| Seminars                       | The lecturer individually supervises resolution of the problems proposed in the seminar lectures.                                                         |
| Introductory activities        | Presentation of the subjects at the beginning of the course.                                                                                              |
| Problem solving                | The lecturer solves problems of similar difficulty to those the student will face later in an autonomous way and attending questions made by the students |

| <b>Assessment</b>                                     |                                                                                                                                                                                                                                                                               |               |                               |    |                                  |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----|----------------------------------|
|                                                       | Description                                                                                                                                                                                                                                                                   | Qualification | Training and Learning Results |    |                                  |
| Essay questions exam                                  | Four problem-solving and question-solving tests distributed throughout the semester, each of which will account 20% of the total score for the subject. These tests will be recoverable.                                                                                      | 80            | A1                            | C2 | D1<br>D3<br>D8                   |
| Report of practices, practicum and external practices | Attendance to the laboratory sessions and realization of laboratory tasks (10%).<br>Subsequent preparation of a report on laboratory activities and realization of a project (10%). Laboratory activities are not recoverable. Laboratory report and project are recoverable. | 20            | B2                            | C2 | D1<br>D3<br>D4<br>D5<br>D6<br>D8 |

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

No minimum score is established for any of the continuous assessment tests.

Commitment of the student to continuous assessment: this commitment is materialized by attending the four exams distributed throughout the semester or by attending any of the recovery tests on the day of the final exam. The student who fail to attend to any of these four exams and to all the recovery tests will receive the grade of "non presentado".

Recovery of continuous assessment tests:

On the day of the final exam, students will be able to recover each of the four exams taken throughout the semester. They will be able to choose which exams they want to recover or improve. The highest score obtained between the recovery exam and the exam carried out during the semester will always be recorded. The students will also have the option of submitting the laboratory report and the project until the day of the final exam in case they did not submit it within the established period or if they just wish to improve it.

Second call and end-of-program call evaluation: it will be done in the same way as the recovery of the first call, but on the dates officially established for each of the calls.

Exam-only assessment:

The student has the right to opt for the global assessment according to the procedure and the deadline established by the centre for each call. Students who opt for this modality will take an exam that covers the contents of the entire subject and might also contain questions or exercises related to laboratory activities.

Examination dates: the exam schedule is published on the website <http://aero.uvigo.es/gl/docencia/exames>

### **Sources of information**

#### **Basic Bibliography**

Griffiths, D.J., **Introduction to electrodynamics**, 3ª edición, Prentice Hall, 1999

Burbano de Ercilla, **Física General**, 31ª, Mira, 1993

Hecht, E., **Óptica**, 5ª ed., Pearson, 2016

#### **Complementary Bibliography**

Wangsness, R. K., **Campos electromagnéticos**, Limusa, 1983

Sears, F. W., Salinger, G. L., **Termodinámica, teoría cinética y termodinámica estadística**, Reverté, 1973

Nilsson, J., **Circuitos eléctricos**, 4ª, Addison Wesley Iberoamericana, 1993

Feynman, R. P., **Física (vol. I)**, Addison Wesley, 1998

Feynman, R. P., **Física, vol. II**, Addison Wesley, 1998

Cheng, D.K., **Fundamentos de electromagnetismo para ingeniería**, Addison Wesley Iberoamericana, 1988

Edminister, J.A., **Circuitos Eléctricos**, McGraw-Hill, 1997

Edminister, J.A., **Electromagnetismo**, McGraw-Hill, 1993

Jackson J.D., **Electrodinámica clásica**, Alhambra, 1980

Serrano, V, **Electricidad y Magnetismo: Estrategias para la resolución de problemas y aplicaciones**, Prentice Hall, 2001

Sabah, N.H., **Electric circuits and signals**, CRC Press, 2008

Callen, H. B., **Termodinámica: introducción a las teorías físicas de la termostática del equilibrio y de la termodinámica**, AC, 1981

Varios, <http://wikipedia.org>,

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## Recommendations

### Subjects that are recommended to be taken simultaneously

Mathematics: Calculus II/O07G410V01201

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

Physics: Physics I/O07G410V01103

Mathematics: Calculus I/O07G410V01101

| IDENTIFYING DATA        |                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| <b>Química: Química</b> |                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Subject                 | Química: Química                                                                                                                                                                                                                                                                                                                                             |                 |      |            |
| Code                    | 007G410V01203                                                                                                                                                                                                                                                                                                                                                |                 |      |            |
| Study programme         | Grao en Enxeñaría Aeroespacial                                                                                                                                                                                                                                                                                                                               |                 |      |            |
| Descriptors             | ECTS Credits                                                                                                                                                                                                                                                                                                                                                 | Choose          | Year | Quadmester |
|                         | 6                                                                                                                                                                                                                                                                                                                                                            | Basic education | 1    | 2c         |
| Teaching language       | Castelán Galego                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Department              |                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Coordinator             | Alonso González, José Luís                                                                                                                                                                                                                                                                                                                                   |                 |      |            |
| Lecturers               | Pérez Paz, Alicia<br>Rivas Siota, Sandra<br>Torres Pérez, María Dolores                                                                                                                                                                                                                                                                                      |                 |      |            |
| E-mail                  | xluis@uvigo.es                                                                                                                                                                                                                                                                                                                                               |                 |      |            |
| Web                     | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                                         |                 |      |            |
| General description     | Os contidos da asignatura pretenden formar aos alumnos nunha diversidade de aspectos teóricos e aplicados (incluíndo estrutura da materia, termoquímica, disolucións, gases, equilibrio químico, electroquímica, cinética química e química orgánica), que resultan necesarios para abordar con posterioridade outras asignaturas específicas da titulación. |                 |      |            |

### Resultados de Formación e Aprendizaxe

|      |                                                                                                                                                                                                                                                                                                                               |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                                                                                                                                                                               |
| A1   | Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo |
| C4   | Capacidade para comprender e aplicar os principios de coñecementos básicos da química xeral, química orgánica e inorgánica e as súas aplicacións na enxeñaría.                                                                                                                                                                |
| D1   | Capacidade de análise, organización e planificación                                                                                                                                                                                                                                                                           |
| 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                                                                                                                                                                                                                                                                     |
| D8   | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                |
| D9   | Capacidade de traballo en equipo de carácter interdisciplinar                                                                                                                                                                                                                                                                 |
| D13  | Sustentabilidade e compromiso ambiental. Uso equitativo, responsable e eficiente dos recursos                                                                                                                                                                                                                                 |

### Resultados previstos na materia

| Expected results from this subject                                                                         | Training and Learning Results |    |                                         |
|------------------------------------------------------------------------------------------------------------|-------------------------------|----|-----------------------------------------|
| Coñecemento, comprensión e aplicación dos principios químicos relacionados coa súa aplicación na enxeñaría | A1                            | C4 | D1<br>D3<br>D4<br>D5<br>D8<br>D9<br>D13 |
| Coñecemento das propiedades químicas máis destacadas en relación co comportamento dos materiais            | A1                            | C4 | D1<br>D3<br>D4<br>D5<br>D8<br>D9<br>D13 |

### Contidos

|                                             |                                                                                                                                                                                                                                |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                       |                                                                                                                                                                                                                                |
| TEMA 1. ASPECTOS XERAIS E CONCEPTOS PREVIOS | 1.1 Magnitudes, dimensións, unidades e sistemas de unidades<br>1.2 Cambios de unidades<br>1.3 Ecuacións dimensionais e adimensionais<br>1.4 Modos de expresión da concentración<br>1.5 Estequiometría e conceptos relacionados |

|                                       |                                                                                                                                                                                                                                                                                     |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEMA 2. O ÁTOMO                       | 2.1 Estrutura e partículas constituíntes<br>2.2 Teoría atómica: orbitais atómicos<br>2.3 Orbitais atómicos e enerxía: estruturas atómicas<br>2.4 Características dos átomos<br>2.5 Isótopos                                                                                         |
| TEMA 3. ENLACE COVALENTE              | 3.1 Natureza do enlace químico<br>3.2 Teoría de Lewis: estruturas moleculares<br>3.3 Xeometría molecular<br>3.4 Teoría de enlace-valencia<br>3.4 Teoría de orbitais moleculares                                                                                                     |
| TEMA 4. ENLACE IÓNICO                 | 4.1 Ións<br>4.2 Sólidos iónicos: natureza<br>4.3 Enerxía de rede<br>4.4 Propiedades dos sólidos iónicos                                                                                                                                                                             |
| TEMA 5. ENLACE METÁLICO               | 5.1 Sólidos metálicos<br>5.2 Enlace metálico                                                                                                                                                                                                                                        |
| TEMA 6. INTERACCIÓNS INTERMOLECULARES | 6.1 Natureza das interaccións intermoleculares<br>6.2 Tipos de interaccións intermoleculares<br>6.3 Interaccións moleculares e estados de agregación da materia                                                                                                                     |
| TEMA 7. GASES E DISOLUCIÓN            | 7.1 Estado gas: características<br>7.2 Gases ideais<br>7.3 Gases reais<br>7.4 Disolucións<br>7.5 Líquidos e disolucións líquidas<br>7.6 Propiedades coligativas das disolucións                                                                                                     |
| TEMA 8. TERMOQUÍMICA                  | 8.1 Calor, enerxía interna e entalpía<br>8.2 Cambios entálpicos asociados a reaccións químicas<br>8.3 Entropía e enerxía libre: criterio de evolución espontánea das reaccións químicas                                                                                             |
| TEMA 9. EQUILIBRIO QUÍMICO            | 9.1 Concepto de equilibrio<br>9.2 Constante de equilibrio<br>9.3 Tipos de equilibrios<br>9.4 Cociente de reacción<br>9.5 Principio de Le Chatelier<br>9.6 Relacións termodinámicas                                                                                                  |
| TEMA 10. EQUILIBRIO ÁCIDO-BASE        | 10.1 Definicións de ácido e base.<br>10.2 Autoionización do auga e produto iónico. pH e pOH<br>10.3 Forteza de ácidos e bases. Cálculo do pH<br>10.4 Ácidos polipróticos<br>10.5 Hidrólisis<br>10.6 Disolucións reguladoras                                                         |
| TEMA 11. EQUILIBRIO DE SOLUBILIDADE   | 11.1 Compostos solubles e pouco solubles<br>11.2 Compostos pouco solubles: solubilidade e produto de solubilidade<br>11.3 Factores que afectan á solubilidade<br>11.4 Precipitación fraccionada                                                                                     |
| TEMA 12. EQUILIBRIO REDOX             | 12.1 Conceptos básicos de oxidación e redución<br>12.2 Reaccións redox: axuste en medio ácido ou básico<br>12.3 Valoracións redox                                                                                                                                                   |
| TEMA 13. ELECTROQUÍMICA               | 13.1 Celas electroquímicas: conceptos básicos<br>13.2 Potenciais estándar de electrodo e de cela<br>13.3 Termodinámica das reaccións electroquímicas<br>13.4 Ecuación de Nerst. Aplicacións<br>13.5 Baterías e pilas<br>13.6 Procesos industriais de electrólisis<br>13.7 Corrosión |
| TEMA 14. CINÉTICA QUÍMICA             | 14.1 Conceptos básicos: velocidade de reacción<br>14.2 Factores que modifican a velocidade dunha reacción química<br>14.3 Determinación da ecuación cinética dunha reacción química                                                                                                 |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEMA 15. INTRODUCCIÓN Á QUÍMICA ORGÁNICA | 15.1 Estrutura dos compostos orgánicos<br>15.2 Alcanos, alquenos, alquinos e derivaddos haloxenados dos hidrocarburos<br>15.3 Hidrocarburos aromáticos<br>15.4 Alcohois, fenoles e éteres<br>15.5 Aldehídos e cetonas<br>15.6 Ácidos carboxílicos, ésteres e derivados<br>15.7 Aminas e amidas<br>15.8 Nitrilos e nitroderivados<br>15.9 Reaccións dos compostos orgánicos<br>15.10 A química orgánica na industria aeroespacial |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Planificación

|                                         | Class hours | Hours outside the classroom | Total hours |
|-----------------------------------------|-------------|-----------------------------|-------------|
| Lección maxistral                       | 24          | 48                          | 72          |
| Seminario                               | 14          | 49.5                        | 63.5        |
| Prácticas de laboratorio                | 12          | 0                           | 12          |
| Resolución de problemas e/ou exercicios | 2           | 0                           | 2           |
| Exame de preguntas obxectivas           | 0.5         | 0                           | 0.5         |

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

### Metodoloxía docente

|                          | Description                                                                                                                                                                                                                                                                               |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lección maxistral        | Expoñeranse os fundamentos teóricos e prácticos de cada un dos temas da materia, co apoio da bibliografía e materiais audiovisuais e estimularase a participación do estudantado nas clases. Ademais, os estudantes realizarán algúns cuestionarios tipo test de forma autónoma.          |
| Seminario                | De xeito paralelo ás sesións maxistras, nos seminarios abordaranse exercicios relacionados coa materia. O estudantado dispoñerá previamente de boletíns que inclúan todos os exercicios da materia e contéplase a posibilidade de que resolvablen de modo autónomo unha parte dos mesmos. |
| Prácticas de laboratorio | O alumnado realizará prácticas relacionadas cos contidos da asignatura co obxectivo de que adquiran destrezas relacionadas co manexo de materiais, reactivos e instrumentos habituais nun laboratorio. Ao finalizar, farán un test sobre os contidos das prácticas.                       |

### Atención personalizada

| Methodologies            | Description                                                                                                                                                                                                                                           |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Seminario                | Estimularase a participación en clase, de xeito que o alumnado poida propoñer cuestións para discusión adicional ou resolver exercicios de aplicación ante os seus propios compañeiros.                                                               |
| Lección maxistral        | Procurarase involucrar ao alumnado nas explicacións, dirixíndolles preguntas e permitíndolles suscitar dúbidas, que eventualmente poderían resultar en temas de discusión que o propio alumnado podería expoñer en clase tras a adecuada preparación. |
| Prácticas de laboratorio | O alumnado contará con asesoramento individual para axudarlles no manexo de instrumentos, identificación de problemas de operación, obtención de datos representativos e análise de erros.                                                            |

### Avaliación

|                          | Description                                                                                                                                                                                                                                                                                                                 | Qualification | Training and Learning Results |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|
| Lección maxistral        | Avaliarase, mediante a realización en aula de varios test, a consecución dos resultados de aprendizaxe e as competencias relacionadas cos contidos teóricos da materia vistos en clases de teoría.                                                                                                                          | 10            | A1 C4 D1 D4 D5 D8             |
| Seminario                | Avaliarase, mediante a resolución en aula de varios problemas, a consecución dos resultados de aprendizaxe e as competencias relacionadas coa aplicación dos conceptos da materia.                                                                                                                                          | 10            | A1 C4 D1 D3 D4 D5 D8 D9       |
| Prácticas de laboratorio | A realización das prácticas é requisito "sine qua non" para aprobar a materia. Ao finalizar as prácticas realizarase unha proba tipo test ou de preguntas de resposta curta sobre os contidos das mesmas que terá un valor de 5%. Tamén se otorga un valor de 5% á actitude e o traballo durante a estancia no laboratorio. | 10            | A1 C4 D1 D4 D5 D8 D9 D13      |

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |    |    |                                  |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|----------------------------------|
| Resolución de problemas e/ou exercicios | Nas datas oficiais farase un exame de resolución de problemas e/ou exercicios da materia, para avaliar a consecución dos resultados de aprendizaxe relacionados coa aplicación a problemas dos conceptos da materia. Previamente, ao longo do curso, fixarase a data para a realización dun exame non oficial de problemas e/ou exercicios da parte A da materia, que terá un valor do 20 % e que se complementará co exame da parte B realizado na data oficial e que terá o mesmo valor (20%). | 40 | A1 | C4 | D1<br>D3<br>D4<br>D5<br>D8<br>D9 |
| Exame de preguntas obxectivas           | Nas datas oficiais farase un examen tipo test para avaliar os resultados de aprendizaxe relacionados cos contidos teóricos da materia. Previamente, ao longo do curso, fixarase a data para un exame non oficial tipo test da parte A da materia e que terá un valor do 15 % e que se complementará co exame da parte B realizado na data oficial, e que terá o mesmo valor (15 %)                                                                                                               | 30 | A1 | C4 | D1<br>D4<br>D5<br>D8             |

## Other comments on the Evaluation

### 1. Sistemas de avaliación

Prantéanse dous sistemas de avaliación: **continua** e **global**.

**1.1. Avaliación continua:** Con carácter xeral, esta será a modalidade de avaliación e a cualificación final determinarase de acordo coas seguintes valoracións:

**I.Prácticas de laboratorio:** ata o **10 %** do valor total da materia.

De forma xeral, a realización das prácticas de laboratorio dunha maneira satisfactoria é requisito indispensable para superar a materia. Por outra parte, realizarase un exame tipo cuestionario, para o cal se fixará unha convocatoria específica. A cualificación das prácticas dependerá da labor experimental realizada no laboratorio e da nota obtida no cuestionario. Esta nota quedará consolidada para a 2ª oportunidade. O alumnado que fixo as prácticas en cursos anteriores conservará a nota conseguida no seu momento.

**II.Entregas de aula (test e problemas):** ata o **20 %** do valor total da materia.

Ao longo do curso, organizarase a realización de 4 entregas: 2 relativas á **parte A** (Temas 1-8 da materia) e 2 relativas á **parte B** (Temas 9-15 da materia). Cada entrega terá unha duración de 1 hora e consistirá en 1 cuestionario de preguntas tipo test e problemas. Todas estas entregas se farán na aula habitual e en horario de clase. A nota das entregas quedará consolidada para a segunda oportunidade.

**III.Exame parcial (parte A):** ata o **35 %** do valor total da materia.

Ao finalizar a parte A da materia (Temas 1-8) realizarase un exame parcial, que é opcional. Considerarase que o parcial está aprobado cando se obteña como mínimo un 3.5/10 en teoría e un 3.5/10 en problemas e 5 no resultado de aplicar a ecuación:

**Nota parcial A=nota teoría\*0.40+ nota problemas\*0.60.**

**IV.Exame parcial (parte B):** ata o **35 %** da nota total da materia

O exame parcial da parte B levarase a cabo nas datas fixadas oficialmente para a 1ª e 2ª oportunidade. Considerarase que o parcial está aprobado cando se obteña como mínimo un 3.5/10 en teoría e un 3.5/10 en problemas e 5 no resultado de aplicar a ecuación:

**Nota parcial B=nota teoría\*0.40+ nota problemas\*0.60.**

Os/as estudantes que superasen o parcial A só terán que examinarse da parte B. Os estudantes que non superaran a parte A ou non se presentaran, terán que examinarse de ámbalas dúas partes nas datas fixadas oficialmente na 1ª e 2ª oportunidade.

### Cálculo da nota final e restricións

A nota final da materia será o resultado de aplicar a seguinte ecuación:

**Nota final=Nota parcial A\*0.35+Nota parcial B\*0.35+Entregas (cuestións e problemas) na aula\*0.20+Prácticas\*0.10**

Para superar a materia terán que obter unha nota global igual ou superior a 5 e ter unhas notas mínimas de 3.5/10 en teoría e 3.5/10 en problemas (calculadas como medias das partes A e B do temario) e non ter notas inferiores a 3 en ningún exame (sexa de teoría, sexa de problemas).

Non obstante, nos casos nos que o resultado de aplicar a ecuación anterior iguale ou supere o valor de 5, pero non se cumpre ningún requisito de notas mínimas dos antes citados, a nota en actas será 4.9 (suspense).

**1.2. Avaliación global:** Os/as estudantes teñen dereito a optar pola avaliación global seguindo o procedemento e o prazo que estableza o centro para cada convocatoria. En todos os casos, a nota final da materia calcularase avaliando un exame que terá o valor do 100% da nota e que se calculará do seguinte xeito:

**Nota final=Nota teoría\*0.40+Nota problemas\*0.50+Nota prácticas\*0.10**

Para superar a materia, terán que obter unha nota igual ou superior a 5. Non obstante, nos casos nos que o resultado de aplicar a ecuación anterior iguale ou supere o valor de 5, pero non se cumpran os requisitos de notas mínimas citados para 1ª e 2ª convocatoria, terán unha nota de 4.9 en actas.

## **2. Convocatoria Fin de Carreira**

Para a convocatoria de Fin de Carreira, a avaliación realizarase mediante un exame de teoría, problemas e prácticas, e a nota calcularase de maneira idéntica á descrita na avaliación global.

## **3. Datas de exames**

As datas dos exames serán as publicadas no taboleiro de anuncios e/ou na web do Centro. O exames realizaranse de forma presencial, salvo que a U. de Vigo decida o contrario.

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

#### **Basic Bibliography**

Petrucchi, R. H., Herring, F.G., Madura, J.D., Bissonnette, C, **Fundamentos de Química**, 10,

M. A. Domínguez, **Problemas resueltos de química. La ciencia básica**, Paraninfo, 2007

J. A. López Cancio, **Problemas de Química**, Prentice Hall, 2000

Chang, R., **Química**, 11,

#### **Complementary Bibliography**

Atkins, P.; Jones, L., **Química**, 2,

E. Quiñó Cabana, **Nomenclatura y formulación de los compuestos inorgánicos**, 2,

Herrero Villén, M.A., Atienza Boronat, J.A., Nogra Murray, P.; Tortajada Genaro, L.A., **La Química en problemas. Un enfoque práctico**, 1,

Llorens Molina, J.A., **Ejercicios para la introducción a la Química Orgánica**, 1,

Sánchez Coronilla, A., **Resolución de Problemas de Química**, 1,

### **Recomendacións**

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

Física: Física II/O07G410V01202

Matemáticas: Cálculo II/O07G410V01201

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

Física: Física I/O07G410V01103

Matemáticas: Cálculo I/O07G410V01101

#### **Other comments**

Os alumnos que cursaron a Química de segundo de Bacharelato teñen unha formación moito máis adecuada que os que non o fixeron. Por tanto, estes últimos deberán realizar un esforzo adicional para porse ao nivel dos primeiros.

Recoméndase, en todo caso, revisar aspectos como cambios de unidades, formulación en química inorgánica, concepto de peso molecular e mol, axuste de reaccións químicas e cálculos estequiométricos con e sin reactivo limitante.

| IDENTIFYING DATA                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |      |            |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|
| <b>Empresa: Administración da tecnoloxía e a empresa</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |      |            |
| Subject                                                  | Empresa:<br>Administración da tecnoloxía e a empresa                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| Code                                                     | O07G410V01204                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |      |            |
| Study programme                                          | Grao en Enxeñaría Aeroespacial                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |      |            |
| Descriptors                                              | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Choose          | Year | Quadmester |
|                                                          | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Basic education | 1    | 2c         |
| Teaching language                                        | Castelán<br>Galego                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |      |            |
| Department                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |      |            |
| Coordinator                                              | Carlos Villamarín, Pablo de                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| Lecturers                                                | Carlos Villamarín, Pablo de                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |      |            |
| E-mail                                                   | pdecarlo@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |      |            |
| Web                                                      | http://aero.uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |      |            |
| General description                                      | A materia ten como obxectivo principal proporcionar ao estudantado unha formación básica en materia económica e empresarial, que lle axude a coñecer e interpretar a realidade socioeconómica na que desenvolverá a súa actividade profesional no sector aeroespacial. Para iso, presentaranse e desenvolveranse diversos conceptos fundamentais da análise microeconómica e macroeconómica, da economía da empresa e, en particular, da xestión da innovación por parte das organizacións empresariais. |                 |      |            |

| Resultados de Formación e Aprendizaxe |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A1                                    | Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo                                                                                                                                                                  |
| 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. |
| 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.                                                                                                                                                                                                  |
| B8                                    | Coñecemento, comprensión e capacidade para aplicar a lexislación necesaria no exercicio da profesión de Enxeñeiro Técnico Aeronáutico.                                                                                                                                                                                                                                                                                                                                                         |
| C6                                    | Coñecemento adecuado do concepto de empresa, marco institucional e xurídico da empresa. Organización e xestión de empresas.                                                                                                                                                                                                                                                                                                                                                                    |
| D1                                    | Capacidade de análise, organización e planificación                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| D9                                    | Capacidade de traballo en equipo de carácter interdisciplinar                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| D10                                   | Capacidade de tratar e actuar en situacións de conflitos e negociación                                                                                                                                                                                                                                                                                                                                                                                                                         |
| D12                                   | Compromiso ético e democrático                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Resultados previstos na materia                                                |                                                               |
|--------------------------------------------------------------------------------|---------------------------------------------------------------|
| Expected results from this subject                                             | Training and Learning Results                                 |
| - Coñecemento, comprensión, análise e síntese da microeconomía e macroeconomía | A1 B5 C6 D1<br>D3<br>D4<br>D5<br>D6<br>D8<br>D9<br>D10<br>D12 |

## Contidos

Topic

Bloque I: Microeconomía

Bloque II: Macroeconomía

Bloque III: Economía da empresa

Bloque IV: Xestión da innovación

## Planificación

|                               | Class hours | Hours outside the classroom | Total hours |
|-------------------------------|-------------|-----------------------------|-------------|
| Actividades introductorias    | 1           | 1                           | 2           |
| Traballo tutelado             | 9           | 4                           | 13          |
| Flipped Learning              | 31          | 81.5                        | 112.5       |
| Resolución de problemas       | 9           | 1                           | 10          |
| Exame de preguntas obxectivas | 1           | 5                           | 6           |
| Presentación                  | 1.5         | 5                           | 6.5         |

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

## Metodoloxía docente

|                            | Description                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Actividades introductorias | Actividades encamiñadas a tomar contacto e reunir información sobre o estudantado, así como a presentar a materia.                                                                                                                                                                                                                                                                                               |
| Traballo tutelado          | O estudantado, 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. É obrigatorio asistir ás clases prácticas para realizar o traballo.                                                                                                                                         |
| Flipped Learning           | Algunhas actividades de aprendizaxe realizaranse fora da aula, e coa presenza do docente se facilitará e potenciará outros procesos de adquisición e practica de coñecementos.                                                                                                                                                                                                                                   |
| Resolución de problemas    | Actividade na que se formulan problema e/ou exercicios relacionados coa materia. O estudantado debe desenvolver as solucións adecuadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. É obrigatorio asistir ás clases prácticas para realizar esta proba. |

## Atención personalizada

| Methodologies           | Description                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Traballo tutelado       | Atención das consultas do estudantado relacionadas co traballo tutelado realizado durante as sesións de clases prácticas. Desenvolverase de forma presencial (directamente na aula ou en titorías). Tamén poderá realizarse por medios telemáticos (correo electrónico, despacho virtual, videoconferencia, ...), baixo a modalidade de concertación previa.      |
| Flipped Learning        | Atención das consultas do estudantado relacionadas cos contidos teóricos da materia. Desenvolverase de forma presencial (directamente na aula ou en titorías). Tamén poderá realizarse por medios telemáticos (correo electrónico, despacho virtual, videoconferencia, ...), baixo a modalidade de concertación previa.                                           |
| Resolución de problemas | Atención das consultas do estudantado relacionadas cos problemas e exercicios resoltos durante as sesións de clases prácticas. Desenvolverase de forma presencial (directamente na aula ou en titorías). Tamén poderá realizarse por medios telemáticos (correo electrónico, despacho virtual, videoconferencia, ...), baixo a modalidade de concertación previa. |

## Avaliación

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

|                               |                                                                                                                                     |    |    |                |    |                                                |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----|----|----------------|----|------------------------------------------------|
| Resolución de problemas       | Entrega e corrección dos exercicios e problemas realizados durante as clases prácticas.                                             | 25 | A1 | B5             | C6 | D1<br>D5<br>D10<br>D12                         |
| Exame de preguntas obxectivas | Exame tipo test dos contidos teóricos da materia desenvolvidos mediante Flipped Learning.                                           | 40 | A1 | B2<br>B5<br>B8 | C6 | D1<br>D4<br>D12                                |
| Presentación                  | Exposición por parte do estudantado ante o docente e os seus compañeiros e compañeiras dos resultados obtidos no traballo tutelado. | 35 | A1 | B2             | C6 | D1<br>D3<br>D4<br>D6<br>D8<br>D9<br>D10<br>D12 |

### Other comments on the Evaluation

**Primeira oportunidade:** o conxunto de criterios de avaliación arriba exposto constitúe o sistema de avaliación continua na primeira oportunidade. É necesario alcanzar un mínimo de 3.5 (sobre 10) en cada proba para poder compensala e superar a materia. Poderá valorarse, adicionalmente, calquera contribución realizada polo estudantado nas sesións presenciais.

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

O estudantado que non siga o procedemento de avaliación continua deberá realizar un exame final, con parte teórica e parte práctica, que supoñerá o 100% da nota (**avaliación global**). A parte teórica consistirá nun exame de preguntas obxectivas (tipo test) e a parte práctica na resolución de problemas e exercicios e dalgún caso relacionado coa temática do traballo tutelado. É necesario alcanzar un mínimo de 3.5 (sobre 10) en cada parte para poder compensala e superar a materia. Mediante este exame, avaliaranse todas as competencias da materia.

**Segunda oportunidade (e convocatoria extraordinaria):** o estudantado que non supere a materia na primeira oportunidade, ten dúas opcións:

- Realizar un exame, con parte teórica e parte práctica, que supoñerá o 100% da nota. A parte teórica consistirá nun exame de preguntas obxectivas (tipo test) e a parte práctica na resolución de problemas e exercicios e dalgún caso relacionado coa temática do traballo tutelado. É necesario alcanzar un mínimo de 3.5 (sobre 10) en cada parte para poder compensala e superar a materia. Mediante este exame, avaliaranse todas as competencias da materia.

- Conservar a nota obtida na Resolución de problemas (25%) e na Presentación (35%), sempre que sexa superior a 3.5 (sobre 10) en cada unha delas, e realizar só o Exame de preguntas obxectivas (40%). É necesario alcanzar un mínimo de 3.5 (sobre 10) nesta proba para poder compensala e superar a materia.

Se en calquera das dúas oportunidades non se aproba a materia por non alcanzar o mínimo nalguna proba ou parte, e a puntuación total é igual ou superior a 5 (sobre 10), a cualificación en actas será 4.9 (sobre 10).

A concreción das actividades para realizar dependerá en gran medida do número de estudantes, medios para traballar en grupo, etc.

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

Na avaliación terase en conta non só a pertinencia e a calidade do contido das respostas, senón tamén a súa corrección lingüística.

As datas e horarios das probas de avaliación das diferentes convocatorias son as especificadas no calendario de probas de avaliación aprobado polo centro para o curso actual. En caso de conflito ou disparidade entre as datas dos exames, prevalecerán as sinaladas na páxina web da Escola.

**IMPORTANTE:** é obrigación do estudantado coñecer e seguir as instrucións relativas ás distintas probas de avaliación, tanto as contidas na Guía docente ou en calquera outro documento de organización da materia que o profesor poña á súa disposición, como as que se lle fagan chegar puntualmente a través das canles habituais (correo electrónico e/ou Moovi).

### Bibliografía. Fontes de información Basic Bibliography

Iborra Juan, M. et al., **Fundamentos de dirección de empresas. Conceptos y habilidades directivas**, 2ª ed., Paraninfo, 2014

Torres López, J., **Introducción a la Economía**, Ediciones Pirámide, 2017

Cepeda González, M.I. et al., **Economía para ingenieros**, Paraninfo, 2004

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#### **Complementary Bibliography**

Fernández Sánchez, E. et al., **Introducción a los negocios para ingenieros**, Paraninfo, 2008

González Domínguez, F.J. y Ganaza Vargas, J.D., **Fundamentos de economía de la empresa**, 2ª ed., Ediciones Pirámide, 2017

Hidalgo Nuchera, A. et al., **La Gestión de la Innovación y la Tecnología en las Organizaciones**, Ediciones Pirámide, 2013

Mankiw, N.G. y Taylor, M.P., **Economía**, Paraninfo, 2017

Schilling, M.A., **Dirección Estratégica de la Innovación Tecnológica**, 2ª ed., McGraw-Hill, 2014

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#### **Recomendacións**

##### **Subjects that continue the syllabus**

Dirección e xestión de proxectos/O07G410V01701

Prácticas en empresas/O07G410V01981

Sistemas da xestión da información/O07G410V01910

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#### **Other comments**

É responsabilidade do estudantado coñecer e consultar os materiais dispoñibles na plataforma de teledocencia Moovi (novidades, documentos, cualificacións) e estar ao tanto dos avisos realizados polo docente.

| IDENTIFYING DATA               |                                                                                      |           |      |            |
|--------------------------------|--------------------------------------------------------------------------------------|-----------|------|------------|
| <b>Tecnoloxía aeroespacial</b> |                                                                                      |           |      |            |
| Subject                        | Tecnoloxía aeroespacial                                                              |           |      |            |
| Code                           | 007G410V01205                                                                        |           |      |            |
| Study programme                | Grao en Enxeñaría Aeroespacial                                                       |           |      |            |
| Descriptors                    | ECTS Credits                                                                         | Choose    | Year | Quadmester |
|                                | 6                                                                                    | Mandatory | 1    | 2c         |
| Teaching language              | Castelán                                                                             |           |      |            |
| Department                     |                                                                                      |           |      |            |
| Coordinator                    | Gómez San Juan, Alejandro Manuel                                                     |           |      |            |
| Lecturers                      | Gómez San Juan, Alejandro Manuel                                                     |           |      |            |
| E-mail                         | alejandromanuel.gomez@uvigo.es                                                       |           |      |            |
| Web                            | http://aero.uvigo.es                                                                 |           |      |            |
| General description            | Esta materia proporciona unha introdución aos fundamentos da Enxeñaría Aeroespacial. |           |      |            |

| Resultados de Formación e Aprendizaxe |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A1                                    | Que os estudantes demostrasen posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral, e adóitase atopar a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo                                                                                                                                                                  |
| 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. |
| B3                                    | Instalación, explotación e mantemento 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.                                                                                                                                                                                                  |
| 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.                                                                                                                                                                                                                                                                                      |
| 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.                                                                                                                                                                                                                                                                                                                                                         |
| C9                                    | Comprender a globalidade do sistema de navegación aérea e a complexidade do tráfico aéreo.                                                                                                                                                                                                                                                                                                                                                                                                     |
| C10                                   | Comprender como as forzas aerodinámicas determinan a dinámica do voo e o papel das distintas variables involucradas no fenómeno do voo.                                                                                                                                                                                                                                                                                                                                                        |
| C13                                   | Comprender a singularidade das infraestruturas, edificacións e funcionamento dos aeroportos.                                                                                                                                                                                                                                                                                                                                                                                                   |
| C17                                   | Coñecemento adecuado e aplicado á enxeñaría de: Os elementos fundamentais dos diversos tipos de aeronaves; os elementos funcionais do sistema de navegación aérea e as instalacións eléctricas e electrónicas asociadas; os fundamentos do deseño e construción de aeroportos e os seus diversos elementos.                                                                                                                                                                                    |
| C18                                   | Coñecemento adecuado e aplicado á Enxeñaría de: Os fundamentos da mecánica de fluídos; os principios básicos do control e a automatización do voo; as principais características e propiedades físicas e mecánicas dos materiais.                                                                                                                                                                                                                                                              |
| 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.                                                                                                                                                                                 |
| D1                                    | Capacidade de análise, organización e planificación                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| D3                                    | Capacidade de comunicación oral e escrita na lingua nativa                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| D4                                    | Capacidade de aprendizaxe autónoma e xestión da información                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| D6                                    | Capacidade de comunicación interpersonal                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| D8                                    | Capacidade de razoamento crítico e autocrítico                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

D9 Capacidade de traballo en equipo de carácter interdisciplinar

D12 Compromiso ético e democrático

D13 Sustentabilidade e compromiso ambiental. Uso equitativo, responsable e eficiente dos recursos

### Resultados previstos na materia

| Expected results from this subject                                                                                        | Training and Learning Results |                                              |                                       |                                                |
|---------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------|---------------------------------------|------------------------------------------------|
| Coñecemento xeral dos distintos sistemas propulsivos dos vehículos aeroespaciais                                          | A1                            | B1<br>B2<br>B3<br>B4<br>B5<br>B7             | C10<br>C17                            | D1<br>D3<br>D4<br>D6<br>D8<br>D9<br>D12        |
| Coñecemento xeral da tecnoloxía aeroespacial                                                                              | A1                            | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B7<br>B8 | C9<br>C10<br>C13<br>C17<br>C18<br>C19 | D1<br>D3<br>D4<br>D6<br>D8<br>D9<br>D12<br>D13 |
| Coñecemento, comprensión e aplicación dos fundamentos do voo atmosférico das aeronaves, incluíndo os lanzadores e misiles | A1                            | B1<br>B2<br>B3<br>B4<br>B6                   | C9<br>C10<br>C17<br>C18<br>C19        | D1<br>D3<br>D4<br>D6<br>D8<br>D9<br>D13        |
| Coñecemento, comprensión e aplicación dos fundamentos do voo orbital dos vehículos espaciais                              | A1                            | B1<br>B2<br>B3<br>B4<br>B7<br>B8             | C10<br>C18                            | D1<br>D3<br>D4<br>D6<br>D8<br>D13              |
| Coñecemento, comprensión e aplicación das distintas infraestruturas aeroportuarias e a navegación aérea                   | A1                            | B1<br>B2<br>B3<br>B4<br>B6<br>B7<br>B8       | C9<br>C13<br>C17<br>C19               | D1<br>D3<br>D4<br>D6<br>D8<br>D9<br>D13        |

### Contidos

| Topic                          |                                                                                                    |
|--------------------------------|----------------------------------------------------------------------------------------------------|
| Tema 1. Industria Aeroespacial | - Introducción á industria aeroespacial<br>- Organizacións aeronáuticas e espaciais                |
| Tema 2. Sistemas de propulsión | - Introducción á propulsión<br>- Propulsión a hélice<br>- Propulsión a chorro<br>- Motores foguete |
| Tema 3. Arquitectura do avión  | - Partes do avión<br>- Materiais<br>- Procesos de fabricación                                      |

|                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tema 4. Fundamentos do voo atmosférico              | Aerodinámica de perfís<br>- Orixe das cargas aerodinámicas<br>- Perfís aerodinámicos<br>- Curvas características<br>- Entrada en perda de perfís<br>- Perfís en réxime compresible<br>Actuacións do avión<br>- Forzas externas sobre o avión<br>- Voo horizontal, rectilíneo e uniforme<br>- Ascenso, descenso e planeo<br>- Viraxe en plano vertical<br>- Viraxe en plano horizontal<br>- Actuacións en pista<br>- Alcance<br>- Autonomía |
| Tema 5. Aeronaves de á xiratoria                    | - Introducción ás aeronaves de ás rotatorias<br>- Análise xeral da aerodinámica de rotores                                                                                                                                                                                                                                                                                                                                                 |
| Tema 6. Vehículos espaciais                         | - Introducción ao voo orbital<br>- Análise de misión.<br>- Análise de traxectorias de vehículos lanzadores<br>- Tipos e clasificación de vehículos espaciais.<br>- Análise xeral dos subsistemas.                                                                                                                                                                                                                                          |
| Tema 7. Infraestruturas Aeroportuarias              | - Sistema Aeroportuario<br>- Lonxitude de pista de voo<br>- Configuración de aeroportos<br>- Terminais Aeroportuarias                                                                                                                                                                                                                                                                                                                      |
| Tema 8. Sistemas de navegación e circulación aéreas | - Seguridade na navegación aérea<br>- Navegación e circulación aérea<br>- Marco xurídico<br>- Convenio de Aviación Civil Internacional<br>- Marco organizativo<br>- Sistema CNS - ATM<br>- Marco técnico<br>- Sistemas non autónomos. Axudas á navegación<br>- Roteiros e cargas aéreas<br>- Organización do espazo aéreo                                                                                                                  |

## Planificación

|                                       | Class hours | Hours outside the classroom | Total hours |
|---------------------------------------|-------------|-----------------------------|-------------|
| Actividades introdutorias             | 1           | 0                           | 1           |
| Lección maxistral                     | 35          | 57.5                        | 92.5        |
| Resolución de problemas               | 12          | 40                          | 52          |
| Exame de preguntas de desenvolvemento | 2           | 0                           | 2           |
| Exame de preguntas de desenvolvemento | 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                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Actividades introdutorias | Actividades encamiñadas a tomar contacto e reunir información sobre o estudantado, así como a presentar a materia.                                                                                                                                                                                                                                                                                  |
| Lección maxistral         | O profesor exporá nas clases teóricas os contidos da materia. O estudantado terá textos básicos de referencia para o seguimento da materia.                                                                                                                                                                                                                                                         |
| Resolución de problemas   | Actividade na que se formulan problemas e/ou exercicios relacionados coa materia. O alumnado debe desenvolver as solucións axeitadas ou correctas mediante a exercitación de rutinas, a aplicación de fórmulas ou algoritmos, a aplicación de procedementos de transformación da información dispoñible e a interpretación dos resultados. Adóitase empregar como complemento da lección maxistral. |

## Atención personalizada

| Methodologies     | Description                                                                                                                                                                                                                                                         |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lección maxistral | O profesor atenderá persoalmente as dúbidas e consultas do alumnado. Atenderanse dúbidas en forma presencial, en especial nas clases de problemas e laboratorio e en titorías, como de forma non presencial, polos sistemas telemáticos dispoñibles para a materia. |

Resolución de problemas O profesor atenderá persoalmente as dúbidas e consultas do alumnado. Atenderanse dúbidas en forma presencial, en especial nas clases de problemas e laboratorio e en titorías, como de forma non presencial, polos sistemas telemáticos dispoñibles para a materia.

| Avaliación                            |                                                                                                                                                                                       |               |                               |                                              |                                       |                                                |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|----------------------------------------------|---------------------------------------|------------------------------------------------|
|                                       | Description                                                                                                                                                                           | Qualification | Training and Learning Results |                                              |                                       |                                                |
| Resolución de problemas               | Entrega de coleccións de problemas propostos despois das sesións presenciais.                                                                                                         | 20            | A1                            | B1<br>B2<br>B3<br>B4<br>B5<br>B6<br>B7<br>B8 | C9<br>C10<br>C13<br>C17<br>C18<br>C19 | D1<br>D3<br>D4<br>D6<br>D8<br>D9<br>D12<br>D13 |
| Exame de preguntas de desenvolvemento | Realizarase un exame parcial sobre os contidos dos temas 1 ao 4.<br>O exame poderá incluír preguntas tipo test, preguntas de desenvolvemento de resposta curta ou longa, e problemas. | 40            | A1                            | B1<br>B2<br>B3<br>B4<br>B6<br>B7<br>B8       | C9<br>C10<br>C13<br>C17<br>C18<br>C19 | D1<br>D3<br>D4<br>D8<br>D13                    |
| Exame de preguntas de desenvolvemento | Realizarase un exame parcial sobre os contidos dos temas 5 ao 8.<br>O exame poderá incluír preguntas tipo test, preguntas de desenvolvemento de resposta curta ou longa, e problemas. | 40            | A1                            | B1<br>B2<br>B3<br>B4<br>B5<br>B7<br>B8       | C9<br>C10<br>C13<br>C17<br>C18<br>C19 | D1<br>D3<br>D4<br>D6<br>D8<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 oportunidade.

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

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

- Unha nota, en cada un dos dous exames parciais de avaliación continua, non inferior a 4.0.
- Entregar todas as prácticas e traballos da asignatura obtendo, como mínimo, unha nota de 3 en cada un deles.
- A nota media entre os 2 exames parciais (40% e 40%) e as prácticas (20%) debe ser superior a 5.0.

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) Avaliación global:

O/A estudante ten dereito a optar pola avaliación global segundo o procedemento e o prazo que establezca o centro para cada convocatoria.

A avaliación do curso na primeira oportunidade realizarase, por defecto, mediante Avaliación Continua. O estudantado que teña unha xustificación poderá 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 alumnado deberá superar o 5 neste exame. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

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

#### Segunda oportunidade e Fin de Carrera

O alumnado que non superase a materia na primeira oportunidade poderá realizarán un exame que supoñerá o 100% da nota. Este exame pode ter unha parte para realizar nunha sala de computadores e / ou laboratorio.

En caso de detección de plaxio en calquera das probas (probas curtas, exames parciais ou exame final), a cualificación final será de SUSPENSO (0) e o feito será comunicado á dirección do centro para os efectos oportunos.

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**Bibliografía. Fontes de información**

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**Basic Bibliography**

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**Complementary Bibliography**

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FRANCHINI, S Y LÓPEZ GARCÍA, O., **Introducción a la Ingeniería Aeroespacial**, Ed. Garceta, 2ª edición,

ANDERSON, J.D., **Introduction to flight**, Ed. McGraw-Hill, 5th edition,

ISIDORO CARMONA, **Aerodinámica y actuaciones de avión**, Ed. Paraninfo,

TORENBEEK, E Y WITTENBERG, H., **Flight Physics**, Springer,

F.J. SÁEZ NIETO, L PÉREZ SANZ Y V.F. GÓMEZ COMENDADOR, **La navegación aérea y el aeropuerto**, Fundación AENA,

M. GARCÍA CRUZADO, **Descubrir la operación de los aeropuertos**, Fundación AENA,

ENAIRE, <https://www.enaire.es>,

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**Recomendacións**

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

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Física: Física I/O07G410V01103

Matemáticas: Álgebra lineal/O07G410V01102

Matemáticas: Cálculo I/O07G410V01101

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