1. BASIC INFORMATION

Course	Materials science
Degree program	Bachelor's Degree in Aerospace and Aircraft Engineering
School	Architecture, Engineering and Design
Year	2
ECTS	6
Credit type	Mandatory
Language(s)	English
Delivery mode	Face to face
Semester	S1
Academic year	25-26
Coordinating professor	José Luis Aguilar García

2. PRESENTATION

This course belongs to the “Materials and production I” module:
• Materials science 6 ECTS (second year)
• Materials elasticity and resistance 6 ECTS (second year)
• Aerospace production and projects 6 ECTS (third year)

The course topics are strictly linked to several subjects of the Aerospace Engineering Career: in the process of conceiving, designing, building, certifying, delivering and maintaining aero structures, materials science is crucial to understand the components of the aero structures and its behaviour.

The Engineering market is requiring an ever-growing emphasis on concurrent engineering, especially between design, stress analysis and manufacturing, reducing the interaction with fellow departments and increasing their efficiency, resulting in shortening the timescale to certification. Best aerospace companies currently fund their success requiring their engineers a balanced mix of knowledge, experience and concurrent work in within and between departments. This course allows the future engineers to enhance their knowledge by a continuous class interaction.

The course contents are: Introduction to materials science and engineering; Structure of materials through atomic structure, interatomic bonding, the structure of crystalline solids and their imperfections, diffusion, phase diagrams and transformations; Properties of materials in terms of mechanics, thermic, optics, electrics, and magnetics; Performance of materials in service (failures of fatigue, fracture, and creep, corrosion and degradation of materials, economic, environmental, and societal issues in materials science); Aerospace materials: metals like steel, aluminium, or titanium, ceramic and polymers, composites; Materials applications, processing and selection.

3. LEARNING OUTCOMES

Knowledge:

CON13 CO09. Adequate knowledge applied to Engineering: The principles of continuum mechanics and techniques for calculating its response.

Specific knowledge of the subject:

- Identify the main characteristics and applications of metals, polymers, ceramics, and composite materials.
- Describe the structure and crystalline geometry of materials.

Skills:

HAB04. Use computer tools to search for bibliographic or information resources (Information Search).

Specific skills of the subject:

- Evaluate material properties.
- Analyse phase diagrams.
- Evaluate the properties of materials in the field of satellite applications (carbon fiber and lightweight aluminium alloys).
- Conduct studies involving technologies and engineering procedures related to the competencies of this module.
- Based on a set of requirements and previous information, conceptualize an engineering problem, outline the approach to solving it, and find the optimal solution. All of this is relative to the competencies of this module.
- Transfer parts of an engineering problem to the laboratory and use this resource as support for resolution.

Competencies:

CP02 CO12. Appropriate knowledge applied to engineering of: basics of fluid mechanics; basic principles of flight control and automation; main characteristics and physical and mechanical properties of materials.

CP03 CO13. Applied knowledge of: the science and technology of materials, mechanics and thermodynamics, fluid mechanics, aerodynamics and flight mechanics, navigation and air traffic, aerospace technology, theory of structures, air transport, economy and production projects; impact on environment.

CP12. Generate new ideas and concepts from known ideas and concepts, reaching conclusions or solving problems, challenges, and situations in an original way in the academic and professional environment.

CP13. Convey messages (ideas, concepts, feelings, arguments), both orally and in writing, strategically aligning the interests of the various parties involved in communication in the academic and professional environment in the field of aerospace engineering.

CP14. Employ information and communication technologies for data search and analysis, research, communication, and learning in the field of aerospace engineering.

CP15. Influence others to guide and lead them towards specific objectives and goals, taking into consideration their viewpoints, especially in professional situations arising from the volatile, uncertain, complex, and ambiguous (VUCA) environments of the current world.

CP16. Collaborate with others in achieving a shared academic or professional objective, actively participating, demonstrating empathy, and practicing active listening and respect for all team members.

CP17. Integrate analysis with critical thinking in an evaluation process of different ideas or professional possibilities and their potential for error, relying on evidence and objective data that lead to effective and valid decision-making.

CP18. Adapt to adverse, unexpected situations that cause stress, whether personal or professional, overcoming them and even turning them into opportunities for positive change.

CP19. Demonstrate ethical behaviour and social commitment in the performance of professional activities, as well as sensitivity to inequality and diversity.

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

4. CONTENT

- Mechanical properties
- Polymers
- Adhesives
- Crystal structure and geometry
- Phase diagrams
- Ceramics
- Application to Satellite Design (Carbon Fiber and Aluminium Alloys)

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Survey of objectives and interests
- Lecture-based class
- Laboratory practices
- Research by groups or problem solving by groups
- Designs
- Field experiences, conferences, visits to companies and institutions

6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Campus-based mode:

Learning activity	Number of hours	Use of AI
Lecture-based class	20	Allowed
Integrative teamwork	60	Assessed
Self-study	50	Promoted
Mentoring, academic monitoring and assessment	20	Allowed/Not Allowed
TOTAL	**150**	

7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Campus-based mode:

Assessment system	Weight	Use of AI
Exam, test and other type of assessment	30-35%	Not Allowed
Reports, articles and informs	15-30%	Assessed
Alternative system of assessment	15-30%	Assessed
Conferences, company-tour visit and experiences in situ	10-10%	Allowed
Transversal-disciplinary skills	10-15%	Promoted

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.
Further details about the AI-use policy will be published through the virtual campus platform once the course has started.

7.1. First exam period

To pass the course in the regular exam session, you must:

- Obtain a final grade (weighted average) of 5.0 or higher out of 10.0 for the course.
- Obtain a grade of 5.0 or higher out of 10.0 in the assessment of class exercises, exercises submitted on the virtual campus, and laboratory practicals.
- Obtain a grade greater than or equal to 5.0 out of 10.0 in the final exam
- 50% attendance at face-to-face sessions.

When the minimum requirements for the weighted average of the assessable activities are not met (the minimum is not reached in any of the above points), the final grade will be:

- the weighted average if its value is less than or equal to 4
- 4 if the weighted average is greater than 4

The grade in the ordinary exam session will be considered NP (Not Presented) when the student has not submitted any assessable activity that forms part of the weighted average.

7.2. Second exam period

To pass the course in the extraordinary exam session, you must:

- Obtain a final grade (weighted average) of 5.0 or higher out of 10.0 for the course.

- Obtain a grade of 5.0 or higher out of 10.0 in the assessment of class exercises, exercises submitted on the virtual campus, and laboratory practicals.

- Obtain a grade greater than or equal to 5.0 out of 10.0 in the final exam

When the minimum requirements for the weighted average of the assessable activities are not met (the minimum is not reached in any of the above points), the final grade will be:

- the weighted average if its value is less than or equal to 4

- 4 if the weighted average is greater than 4

Activities that were not passed in the regular exam period must be resubmitted after receiving the corresponding corrections from the teacher, as well as those that were not submitted.

8. SCHEDULE

This table shows the delivery deadline for each assessable activity in the course:

Assessable activities	Deadline
Presentation by the teacher of the theoretical contents of the subject.	Week 1-17
Search for information and delivery of working plan for the integrative project.	Week 4-8
Laboratory practices.	Week 7-12
Taking an intermediate knowledge test.	Week 7-10
Resolution of exercises, problems, tests and practical work in the classroom.	Week 1-17
Completion of the integrative project. Presentation of integrative project. Exam and final evaluation.	Week 17-18

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

Here is the recommended bibliography:

- Mechanical Behavior of Materials, Second Edition ©2000 | Courtney | McGraw-Hill Higher Education — USA.
- Aerospace Materials. Cantor, B. et. all. In Series in Materials Science and Engineering. Bristol: CRC Press. 2001.
- Introduction to Composite Materials; Tsai, S.W., and Hahn, H.T., Technomic Publishing Co., Westport, CT, 1980.
- Composites in aerospace industry. Source: Industrial Ceramics. Sep2009, Vol. 29 Issue 2, p119126. 8p. Author(s): Cavalier, J. C.; Berdoyes, I.; Bouillon, E.
- Materials science and engineering / William D. Callister, Jr., David G. Rethwisch. John Wiley & Sons | 2011 | 8th ed.
- Introduction to materials science for engineers / James F. Shackelford Shackelford, James F. 2005

- Materials science and technology: a comprehensive treatment / edited by R.W. Cahn, P. Haasen, E.J. Kramer Wiley-VCH | 1998.
- The behavior of sandwich structures of isotropic and composite materials / Jack R. Vinson Vinson, Jack R. (1929-) Technomic Publishing Company | 1999.
- Finite element analysis of composite materials using ANSYS / Ever J. Barbero Barbero, Ever J. Taylor & Francis | 2014 | 2nd ed
- An introduction to composite materials / D. Hull and T.W. Clyne Hull, Derek. Cambridge University | 1996 | 2nd. ed

10. DIVERSITY MANAGEMENT UNIT

Students with specific learning support needs:

Curricular adaptations and adjustments for students with specific learning support needs, in order to guarantee equal opportunities, will be overseen by the Diversity Management Unit (UAD: Unidad de Atención a la Diversidad).

It is compulsory for this Unit to issue a curricular adaptation/adjustment report, and therefore students with specific learning support needs should contact the Unit at unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.