# 1. BASIC INFORMATION

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|---|---|
| **Course** | Physical Foundations of Engineering I |
| **Degree program** | Degree in Aerospace Engineering in Aircraft |
| **School** | Architecture, Engineering and Design |
| **Year** | First |
| **ECTS** | 6 ECTS |
| **Credit type** | Degree Requirement |
| **Language(s)** | Spanish and English |
| **Delivery mode** | Campus based |
| **Semester** | First |
| **Academic year** | 2024-2025 |
| **Coordinating professor** | Rafael Escalera Rivas |
| **Professor** | Rafael Escalera Rivas |

# 2. PRESENTATION

The basic subject "Physics" is made up of two courses: Physical Foundations of Engineering I & II. They both together provide a solid foundation in the fundamental aspects of classical applied Physics. This guide corresponds to the first of these subjects, which focuses on Mechanics and Thermodynamics. It is intended that students be able to identify, model, pose and solve practical situations that involve forces, energy exchanges and thermodynamic processes. The course is focused so that the student incorporates the scientific method into their way of working, always according to the “Project Based School” model, the hallmark of our School.

# 3. KNOWLEDGE, SKILLS AND COMPETENCIES

**Knowledge**

CON01FB02. Understanding and mastery of the basic concepts of the general laws of mechanics, thermodynamics, fields and waves, and electromagnetism, and their application to solving engineering problems.

CON19. Identify the knowledge of basic subjects and technologies, enabling the student to learn new methods, theories and technologies, and endowed it with great versatility to adapt to new situations (autonomous learning).

Specific knowledge of the subject:

- Identify the basic principles of thermodynamics.

**Skills**

HAB01 FB01. Ability to solve mathematical problems that may arise in engineering. Aptitude to apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial differential equations; numerical methods; numerical algorithms; statistics, and optimization.

Specific skills of the subject:

- Solve problems in applied physics.
- Prepare structured and rigorous engineering reports (based on laboratory practices).
- Solve problems based on the principles of kinematics.
- Solve problems based on the principles of dynamics.

**Competencies**

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 behavior and social commitment in the performance of professional activities, as well as sensitivity to inequality and diversity.

## 4. CONTENT

The contents of the subject cover three fields of classical physics:

- Kinematics
- Dynamics
- Introduction to Thermodynamics

In more detail, these contents are organized into the following units:

**Unit 1: KINEMATICS OF THE PARTICLE**
In this unit we will describe the motion of a particle and introduce the most common kinematic models.
Contents: Scalar and vector quantities. Motion along a straight line. Curvilinear motion. Circular motion: intrinsic components of acceleration. Relative speed…

**Unit 2: PARTICLE DYNAMICS: FORCES**
The main objective of this unit is to introduce Newton's Laws of dynamics and their application to solving particle mechanics problems.
Contents: Newton's laws of dynamics. Common forces: gravitational, elastic, friction, electrostatic ... Free body diagrams. Particles in equilibrium. Particle dynamics. Dynamics of circular motion.

**Unit 3: PARTICLE DYNAMICS: ENERGY**
This unit complements the previous one by introducing an alternative description of the dynamics, based on the energy balance of the particle.
Contents: Work and Kinetic Energy. Power. Common potential energies: gravitational, elastic, electrostatic ... Conservation of mechanical energy. Non-conservative forces. Mechanical performance.

**Unit 4: INTRODUCTION TO THERMODYNAMICS**
In this unit the Principles of Thermodynamics are presented and some of its most important applications to engineering are discussed.
Contents: Heat and Temperature. Calorimetry and phase changes. Heat transmission mechanisms. First Law of thermodynamics. Second principle of thermodynamics. Thermal machines.

**Unit 5: PHYSICS LAB**
This unit is studied throughout the entire subject, as its contents are not associated with any specific topic.
Contents: Physical units of measurement. Treatment of experimental errors. Preparation of reports. Mechanics Laboratory. Thermodynamics Laboratory.

## 5. TEACHING-LEARNING METHODOLOGIES

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

- Survey of objectives and interests
- Master class
- Laboratory practices
- Group research or group problem solving
- 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 |
|---|---|
| Lectures / masterclasses | 60 hours |
| Laboratory | 24 hours |
| Integrative group work | 76 hours |
| Self-study | 140 hours |
| **TOTAL** | **300 hours** |

# 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 |
|---|---|
| SE1 Final Exam | 35% |
| SE2 Group Project | 20% |
| SE3 Problem-Solving sessions | 20% |
| SE4 Other activities, including off-class events such as conferences and seminars (*) | 10% |
| SE5 Lab practices | 15% |

(*) If these activities could not be carried out, the corresponding weight would split evenly between systems SE02 and SE03

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.

## 7.1. First exam period

To pass the course in the first exam period, you must meet all the following requirements:

- Obtain a final course grade of at least 5 out of 10 (weighted average).
- Obtain a group project grade of at least 5 out of 10.
- Attend at least 50% of classes.
- Obtain at least 5 of 10 on the weighted average between problem-solving sessions and final exam.

$$\frac{(PSS \cdot 0.2 + FE \cdot 0.35)}{0.55} \geq 5$$

If any of the above requirements are not met, the final grade may not exceed 4.0 points - failure.

### 7.2. Second exam period

To pass the course in the second exam period, you must obtain a final grade of at least 5 out of 10 (weighted average).

The student must deliver the activities not successfully completed in the first exam period after having received the corresponding corrections from the professor, or those that were not delivered in the first place.

There will be no problem-solving sessions on the second exam period; on the other hand, final exam will weight 65% of final grade.

As in the first exam period, it is mandatory to pass final exam and group project in order to pass the subject.

## 8. SCHEDULE

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

| Assessable activities | Deadline |
|---|---|
| Individual activity 1 | 3th week |
| Individual activity 2 | 5th week |
| Individual activity 3 | 9th week |
| Individual activity 4 | 12th week |
| Presentation of team project | 13th week |
| Individual activity 5 | 14th week |
| Final Exam | 16th week |

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

The main reference work for this subject is:


- Young H.D., Freedman R.A., Sears F.W. and Zemansky M.W. “University Physics” 14th edition (2019), Ed. Pearson.
- Tipler P.A. and Mosca G., “Physics for Scientists and Engineers”, 6th edition (2010), Ed. W.H. Freeman.


The recommended Bibliography is:

- Beer F.P., Johnston E.R. & Mazurek D.F., "Vector Mechanics for Engineers: Statics" 12th edition (2018), Ed. McGraw-Hill.
- Beer F.P., Johnston E.R. & Cornwell P.J., "Vector Mechanics for Engineers: Dynamics" 12th edition (2018), Ed. McGraw-Hill.
- Meriam J.L. & Kraige L.G. "Engineering Mechanics. Statics", 9th edition (2018), Ed. Wiley.
- Meriam J.L. & Kraige L.G. "Engineering Mechanics. Dynamics", 9th edition (2018), Ed. Wiley.

The following high-quality resources are available on-line, free of charge:

- Feynman R., Sands M. y Leighton R., "The Feynman lectures on Physics, Vol. 1: Mainly Mechanics, Radiation and Heat", available on-line in the CalTech site: www.feynmanlectures.caltech.edu
- Schiller C., "Motion Mountain: The adventure of Physics", available on-line in the website of the author: www.motionmountain.net

## 10. DIVERSITY MANAGEMENT UNIT

From the Educational Guidance and Diversity Unit we offer support to our students throughout their university life to help them reach their academic achievements. Other main actions are the students inclusions with specific educational needs, universal accessibility on the different campuses of the university and equal opportunities.

From this unit we offer to our students:

1. Accompaniment and follow-up by means of counselling and personalized plans for students who need to improve their academic performance.
2. In terms of attention to diversity, non-significant curricular adjustments are made in terms of methodology and assessment for those students with specific educational needs, pursuing an equal opportunities for all students.
3. We offer students different extracurricular resources to develop different competences that will encourage their personal and professional development.
4. Vocational guidance through the provision of tools and counselling to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa@universidadeuropea.es

## 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.