

Degree	Type	Year	Semester
2500097 Physics	FB	2	2

## Contact

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## Use of languages

Principal working language: spanish (spa)  
Some groups entirely in English: No  
Some groups entirely in Catalan: No  
Some groups entirely in Spanish: No

## Prerequisites

It is recommended a basic knowledge of physics and mathematics; and be eager to work and learn

## Objectives and Contextualisation

This course provides an introduction to the microscopic and macroscopic view of matter. It starts with a microscopic description, from elementary particles to superconductors, passing from atomic nuclei, atoms, molecules and solids. It follows a thermodynamic description, almost independent of the microscopic details of the system. The microscopic part of the course is introductory. The macroscopic one is given in more depth, establishing and working the fundamental laws of thermodynamics.

### Objectives:

- 1) Understand the basic concepts of the structure of matter (kinetic theory of gases, elementary particles, quantum physics, atomic physics, nuclear physics, physics of solids) at an introductory level.
- 2) Understand the fundamental laws of thermodynamics, and to know how to apply them.
- 3) Identify and solve characteristic problems of these areas of physics
- 4) Show some aspects of the unity of physics, and the relationship between macroscopic and microscopic descriptions
- 5) To relate the physical aspects of everyday life and nature around us
- 6) Discuss the relationship between theoretical models and real physical systems

## Skills

- Carry out academic work independently using bibliography (especially in English), databases and through collaboration with other professionals
- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics
- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Develop strategies for analysis, synthesis and communication that allow the concepts of physics to be transmitted in educational and dissemination-based contexts

- Formulate and address physical problems identifying the most relevant principles and using approximations, if necessary, to reach a solution that must be presented, specifying assumptions and approximations
- Know the fundamentals of the main areas of physics and understand them
- Respect the diversity and plurality of ideas, people and situations
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation

## Learning outcomes

1. Analyse and interpret the main experiments related to basic physics.
2. Analyse certain open questions in contemporary physics and explain them clearly.
3. Apply quantum physics in simple devices of industrial interest (diodes, light-emitting diodes, lasers, solar cells).
4. Carry out academic work independently using bibliography (especially in English), databases and through collaboration with other professionals
5. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
6. Contrast the sharpness of mathematical results with margins of error in experimental observations.
7. Describe the basis of heat engines, refrigerators and heat pumps.
8. Describe the structure of the atom and molecules, and corresponding spectra.
9. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
10. Develop independent learning strategies.
11. Identify the consequences of the second law of thermodynamics.
12. Interact across diverse areas of basic physics.
13. List and describe the four principles of thermodynamics.
14. Make mathematical rigor compatible with approximate physical modelling.
15. Relate nuclear interaction with radioactivity and nuclear reactions.
16. Relate quantum physics with the electrical conductivity properties of materials.
17. Relate the basic concepts of physics with scientific, industrial and everyday subjects.
18. Respect diversity in ideas, people and situations.
19. Select good variables and carry out correct simplifications.
20. Use complex numbers.
21. Use differential and integral calculus.
22. Use linear transformations and matrix calculus.

## Content

### Structure of Matter

Kinetic theory: pressure and temperature  
 Equipartition Theorem and specific heats  
 Planck and Einstein-de Broglie Relations  
 Bohr model of the hydrogen atom  
 Pauli exclusion and periodic table of chemical elements  
 Atomic nuclei. Nuclear forces. Nuclear reactions. Radioactivity.  
 Elementary particles, quarks, leptons, intermediary bosons  
 Semiconductors and metals. Diodes, transistors, solar cells, LEDs, lasers.  
 Macroscopic coherent effects. Bose-Einstein condensates, superconductors

### Thermodynamics

Heat transport. Conduction, convection and radiation  
 Zero Principle. Temperature. Equations of state  
 First law of thermodynamics. Heat, work, internal energy. Heat engines  
 Second Law of Thermodynamics (I). Statements of Clausius and Kelvin-Planck. Carnot's theorem. Absolute

temperature

Second Law of Thermodynamics (II). Entropy. Degradation of energy. Thermodynamic potentials. Gibbs equation

## Methodology

This course provides an introduction to the microscopic and macroscopic view of matter. In some subjects, which are relatively simple equations, the description is quantitative; in others, it is more qualitative endeavoring to introduce a clear conceptual framework, which can naturally raise questions and bring interest in the development of the courses offered by the subjects later. The thermodynamic block is exposed in higher depth, establishing the solid grounds of its principles.

It seeks to allow the subject into contact with some of the most active borders of physics today, so that the student may already have the feeling that it is a living science. And it will highlight the relationship between physics and nature, everyday life and technology.

## Activities

Title	Hours	ECTS	Learning outcomes
<b>Type: Directed</b>			
Master class	30	1.2	2, 1, 3, 14, 6, 7, 8, 10, 9, 13, 11, 17, 16, 15, 12, 18, 19, 21, 20, 22
Problems class	22	0.88	2, 1, 3, 14, 6, 7, 8, 10, 9, 13, 11, 17, 16, 15, 12, 18, 19, 21, 20, 22
<b>Type: Supervised</b>			
Delivery activities	5	0.2	2, 1, 3, 14, 6, 7, 8, 10, 9, 13, 11, 17, 16, 15, 12, 18, 19, 21, 20, 22
<b>Type: Autonomous</b>			
Personal work	64	2.56	2, 1, 3, 14, 5, 6, 7, 8, 10, 9, 13, 4, 11, 17, 16, 15, 12, 18, 19, 21, 20, 22

## Evaluation

The evaluation consists of:

1. Delivered problems and projects. (15% of the overall score)

It will consist of the presentation of selected problems solved and projects on divulgative articles.

2. Exams. (85% of the overall score)

- There will be two partial exams, one for each block of the course. Each of these tests has the same weight.

- Final written exam.

**Important:** To pass the course the mark of each partial exam must be greater than 4 (in a scale of 10) and the average grade of the course greater than 5.

For students who have not passed the subject through partial exams or for those who wish to improve the grade, they can go to the final exam and do each part separately. The grade on the final exam will replace the previously obtained if it is higher.

## Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Delivered exercises	15%	20	0.8	5, 4
Final exam	85%	3	0.12	2, 1, 3, 14, 5, 6, 7, 8, 10, 9, 13, 4, 11, 17, 16, 15, 12, 18, 19, 21, 20, 22
Two partial exams	85%	6	0.24	2, 1, 3, 14, 5, 6, 7, 8, 10, 9, 13, 4, 11, 17, 16, 15, 12, 18, 19, 21, 20, 22

## Bibliography

In the microscopic part, we will follow P. Tipler and A. Mosca, Física, 6 edición, Editorial Reverté, Barcelona, 2010.

In the Thermodynamics part we will go deeper:

- M. Criado-Sancho y J. Casas-Vázquez, Termodinámica química y de los procesos irreversibles, 2ª edición, Addison Wesley, Madrid, 2004
- M.W. Zemansky y R.H. Dittman, Calor y termodinámica, sexta edición, McGraw-Hill, Madrid, 1990
- C.J. Adkins, Termodinámica del equilibrio, Reverté, Barcelona, 1977.
- D. Kondepudi & I. Prigogine, Modern Thermodynamics, Wiley (1998).
- H. Callen, Termodinámica, Editorial A.C, Madrid, 1985