UAB
Universitat Autònoma de Barcelona

Structure of Matter

Code: 107593
ECTS Credits: 6

2025/2026

Degree	Type	Year
Physics	FB	1

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Elementary knowledge of physics and mathematics is required. This is a first-year subject.

Objectives and Contextualisation

This subject provides an introduction to the description of the properties of matter in its different states (solid, liquid and gaseous). It begins with a brief introduction to the quantum physics necessary to describe atoms. It continues with a description of semiconductor solids and metals, continuing with the statics and dynamics of fluids to end with a brief introduction to calorimetry, heat transport and the description of ideal gases.

Objectives:
1) Understand the basic concepts of the structure of the subject at an introductory level.
2) Knowing how to identify and solve the most characteristic problems of these areas of physics
4) To show some aspects of the unity of physics, and of the relationship between macroscopic descriptions and
microscopic
5) Relate physics to some aspects of daily life and the nature that surrounds us
6) Comment on the relationship between theoretical models and real physical systems

Learning Outcomes

1. CM01 (Competence) Solve problems in the sciences using the fundamentals of the main areas of physics in a professional context.
2. CM02 (Competence) Evaluate the principal magnitudes involved in a given basic physical system, manipulating them according to fundamental physical laws to draw conclusions about the predictable behaviour of the system under study.
3. KM01 (Knowledge) State Newton's laws and their relationship with the movement of particles and fluids.
4. KM04 (Knowledge) Identify the basic structure of the atom and matter.
5. SM01 (Skill) Correctly use scientific language, magnitudes and units associated with fundamental physical concepts.
6. SM02 (Skill) Apply the theory, fundamentals and numerical methods of general physics to the resolution of simple problems and the explanation of experimental phenomena.

Content

1. Einstein-Planck and De Broglie relations

1.1 Blackbody radiation. Stefan-Boltzmann and Wien laws. Ultraviolet catastrophe.

1.2 Planck's hypothesis. Planck's law of blackbody radiation.

1.3 Corpuscular nature of light: photoelectric effect and Compton scattering.

1.4 Wave-corpuscle duality. De Broglie hypothesis. Heisenberg's uncertainty principle.

2. Atomic models

2.1 Historical introduction to the atom. Atomic spectra. Rydberg's law.

2.2 Thomson, Rutherford and Bohr atomic models

2.3 Quantum theory of atoms. Schrödinger equation for the Hydrogen atom.

2.4 Quantum numbers: quantification of energy and angular momentum. Atomic orbitals. Notation and form.

2.5 Stern-Gerlach experiment. Spin

3. Semiconductors and metals.

3.1 Crystalline solids. Unit cell. Crystalline structures.

3.2 Metallic crystal. Electron gas model. Electrical conductivity: conductors, insulators and semiconductors

3.3 Classical model of electrical conduction (Drude model)

3.4 Diodes, transistors, photovoltaic cells, LEDs, lasers.

4. Fluid statics

4.1 Concept of fluid. Density. Hydrostatic pressure and units

4.2 Pascal's principle. Fundamental equation of hydrostatics

4.3 Atmospheric pressure. Torricelli's experiment. Manometer

4.4 Buoyancy and Archimedes' Principle. Flotation

4.5 Surface Tension. Capillaries

5. Fluid Dynamics

5.1 Ideal fluids. Streamline. Steady flow

5.2 Continuity equation. Bernoulli equation

5.3 Applications: Torricelli formula, Venturi tube and Pitot tube

5.4 Real fluids. Viscosity. Poiseuille's law. Reynolds number

6. Calorimetry

6.1 Thermal equilibrium. Temperature. Thermal expansion. Temperature scales.

6.2 Heat. Heat capacity. Specific heat. Measurement of specific heats

6.3 States of aggregation of matter. Phase changes. Latent heat. Fusion. Vaporization. Phase diagrams

7. Ideal gas

7.1 Ideal gas. Macroscopic model. Equation of state. Ideal gas laws.

7.2 Kinetic model. Microscopic interpretation of pressure and temperature

7.3 Microscopic description of specific heat. Equipartition theorem. Dulong and Petit's law

7.4 MB velocity distribution? (if time remains)

8. Heat transport

8.1 Heat transport mechanisms. Heat conduction. Fourier's law. Convection. Radiation.

8.2 Heat conduction equation.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
problem lessons	14	0.56	CM01, CM02, KM04, SM01, SM02, CM01
Theory lectures	28	1.12	CM02, KM01, KM04, SM01, CM02
Type: Supervised			
Seminars and group activities	8	0.32	CM01, CM02, KM01, KM04, SM01, SM02, CM01
Type: Autonomous			
self-study	90	3.6	CM01, CM02, KM01, KM04, SM01, SM02, CM01

This subject provides an introduction to the microscopic and macroscopic view of the subject. In some topics, where the equations are relatively simple, the description is more quantitative; in others, it is more qualitative, trying to introduce a clear conceptual framework, in which questions can be raised in an appropriate and

natural way that leads to interest in the development offered by the subjects of the subsequent years.
We try, as far as possible, that the subject allows us to come into contact with some of the most active frontiers of current physics, so that the student can already have the feeling that they are in a living science. And we will also try to highlight the relationship between physics and nature, everyday life, and technology.

Note: 15 minutes of a class will be reserved, within the calendar established by the center/degree, for the students to complete the surveys to evaluate the performance of the teaching staff and the evaluation of the subject/module.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluation of seminars	15%	1	0.04	CM01, CM02, KM01, KM04, SM01, SM02
make-up examination	85%	3	0.12	CM01, CM02, KM01, KM04, SM01, SM02
Two partial exams	85%	6	0.24	CM01, CM02, KM01, KM04, SM01, SM02

The assessment consists of:

1.- Exams (85% of the overall grade)

- There will be 2 partial exams, each with the same weight

- Make-up exam.

2.- Evaluation of seminars and group activities (15% of the overall grade)

- In the seminars, students will do different group activities that will be delivered and evaluated. The teaching staff reserves the right to ask students oral questions if they deem it appropriate.

The grade will therefore be obtained with the following formula: 0.85*(Partial1 + Partial2)/2 + 0.15*(seminars)

Important: To pass the subject, the grade of each partial exam must be higher than 4 (out of 10) and the average of the course must be higher than 5.

Retake: In order to take the make-up exam, students must have passed both partial exams. Each partial exam is taken separately.

Anyone who wants to improve their grade can take the retake exam. If the grade you get in the retake exam (in each part) is up to 1.5 points lower than the grade for the part, we will keep the part grade (unless you get less than 4). If you think you will not improve your grade, you can not take the exam.

SINGLE EVALUATION

Students who have opted for the single evaluation method must take a final test that will consist of a written exam that will consist of solving problems and theoretical questions about the entire course content. This test will be held on the same day as the second exam of the continuous assessment (second part). Then, on the same day, they will have to take an oral exam that replaces the evaluation of seminars and group activities.

The final grade is obtained in the same way as in continuous assessment: the exam weighs 85% of the final grade (both blocks weigh the same) and the oral exam 15%.

Important: To average the other 15% of the grade, a grade greater than or equal to 4 out of 10 must be obtainedin the exam.

If the exam grade does not reach 4 or the final grade does not reach 5, there will be a retake exam that will be held on the date set by the degree coordination. The retake exam will follow the same procedure as the single assessment.

Bibliography

P. Tipler and A. Mosca, Physics, 6th edition, Editorial Reverté, Barcelona

Teachers' transparencies.

Software

No software is required for this course.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	second semester	afternoon
(SEM) Seminars	11	Catalan	second semester	morning-mixed
(SEM) Seminars	12	Catalan	second semester	morning-mixed
(SEM) Seminars	21	Catalan	second semester	afternoon
(SEM) Seminars	22	Catalan	second semester	afternoon
(TE) Theory	1	Catalan	second semester	morning-mixed
(TE) Theory	2	Catalan	second semester	afternoon