Academic year 2026/2027

Guía Docente:

FÍSICA

FACULTAD DE CIENCIAS QUÍMICAS

1. IDENTIFICATION

Qualification	Bachelor's Degree in Chemical Engineering			Code	801533
Subject	Physics			ECTS	9
Subject matter	Physics				
Module	Basic				
Character	Basic	Course	First	Semester	Annual
Responsible department	Physics of Materials (Faculty of Science) Physical)				

Responsible teachers

Group A

Activity	Teacher	Email	Office
Tª/S/Tut. 1st quad.	ROUCO GÓMEZ	vrouco@ucm.es	03.249.0
Tª/S/Tut. 2nd quadri.	JUAN IGNACIO BELTRAN	juanbelt@ucm.es	02.104.0

Group B

Activity	Teacher	Email	Office
Tª/S/Tut. 1st quad.	YANICET ORTEGA	yanicet@fis.ucm.es	02.126.0
Tª/S/Tut. 2nd quadri.	YANICET ORTEGA	yanicet@fis.ucm.es	02.126.0

Laboratory teachers (General Physics Laboratory, Faculty of CC. Physics, Central Basement)

Group	Quad.	Teacher	Email	Office
A	1	P. Alcazar	pedrolua@ucm.es	Research Staff 2
A	1	C. Ares	clauares@ucm.es	Research Staff 3
B	1	C. Gutierrez	clagut02@ucm.es	Research Staff 3
B	1	C. Ares	clauares@ucm.es	Research Staff 3

2. OBJECTIVES

General Objective

The objectives pursued by the teaching of the subject of Physics are that the student acquires:

1. The knowledge of Physics required by the teaching of the rest of the degree, plus that which is necessary to respect the logical structure of the discipline and to adapt to the student's previous training.

1. The ability to apply this knowledge, materialized in the acquisition of the necessary skills to, in particular cases, be able:

1. Identify them with theoretical models.
2. Recognize the physical variables relevant to the phenomenon described.
3. Apply the laws and general principles.
4. Interpret specific physical conditions and formulate them quantitatively.
5. Acquire habits of experimentation.
6. Acquire habits of interpretation and analysis, evaluating results and identifying the implications and relationships they contain.

It is intended to provide the student with:

7. Instrumental ability to assimilate the disciplines of the career that are based on the subject matter of the subject.
8. Ability to apply the theoretical models of the subject matter in real contexts and to critically assess the results of the application.
9. Rigour, agility and habit in the use of the scientific-technical methodology of the subject matter for further training and professional practice.

Specific objectives

Among the specific objectives, the following can be highlighted:

10. Have a clear knowledge of the fundamental and derived physical quantities and the units used.
11. Consolidate knowledge of the principles of Newtonian Mechanics.
12. Relate the magnitudes of work and energy and know how to solve problems according to purely energy criteria.
13. Acquire basic knowledge related to the concept of field, emphasizing electric and magnetic fields and also electrostatic forces and potentials related to those produced by molecular ions and dipoles.
14. Apply the concept of field to the study of the electric field produced by electric charges and to the study of the magnetic field produced by moving charges.
15. To study the behaviour of electric charges and currents inside electric and magnetic fields.
16. To study mechanical and electromagnetic waves as carriers of energy and quantity of movement.
17. Know electromagnetic radiation and the electromagnetic spectrum.
18. Understand the fundamentals of physical optics, in particular the phenomena of interference and diffraction of waves.

3. BACKGROUND KNOWLEDGE AND RECOMMENDATIONS

Background knowledge

It is advisable that students who enroll in this subject have studied Physics and Mathematics in the last year of Baccalaureate, since it is necessary to master the knowledge of these subjects with ease. Likewise, it is advisable for the student to have knowledge of vector calculus and differential and integral calculus.

Recommendations

It is advisable that the student has a basic level of English that allows him or her to handle bibliography in English, and communicate in writing in that language. It is also advisable for

the student to be familiar with tools and computer programs for data processing and graphing.

4. CONTENTS

Brief description of the contents

Magnitudes, units and dimensional analysis. Mechanics and Newton's laws. Work and energy. Particle systems. Fluids. Oscillatory and wave motion: mechanical waves and electromagnetic waves. Field and electric potential. Magnetic field and magnetic induction. Wave optics.

Program

FIRST PARTIAL

Topic 1: Unit and Vector Systems

1. Magnitudes. Unit systems.
2. Dimensional analysis.
3. Vectors: definition and reference systems.
4. Operations with vectors.
5. Cartesian components of a vector. Unit vector.

Topic 2: Cinematics. Dynamics of a particle. Newton's Laws

6. Kinematics.
7. Newton's laws.
8. Most important types of force.
9. Impulse of a force.
10. Dynamics of circular motion: components of force.

Topic 3: Work and energy

11. Work.
12. Power.
13. Kinetic energy.
14. Potential energy: conservative force fields.
15. Principle of conservation of mechanical energy.
16. Non-conservative forces: principle of conservation of energy.
17. Work-energy theorem.
18. Discussion of potential energy curves.

Topic 4: Oscillatory Motion

19. Definition of simple harmonic motion (MAS).
20. Elastic strength: Hooke's law.
21. General equation of an MAS. Parameters that define a MAS.
22. Potential, kinetic and mechanical energy of the MAS.
23. Some oscillating systems: object hanging from a vertical spring and the simple pendulum.

Topic 5: Particle System I: Linear Momentum and Collisions

24. Center of mass (CM). Calculation of the CM of discrete particle systems.
25. Translational motion of the CM of the particle system.
26. Conservation of linear momentum.
27. Energy of a particle system: conservation of energy.
28. Collisions.

Topic 6: Particle Systems II: Angular Momentum and Rotation

29. Rotational motion of the CM of the particle system: moment of a force, moment of inertia, and angular momentum.
30. Dynamics of the rotation of the particle system.
31. Conservation of angular momentum.
32. Rotational kinetic energy.

Topic 7: Fluids

33. Pressure at a point in a fluid.
34. Viscosity.
35. Fluids in motion:
36. Principle of conservation of matter: continuity equation.
37. Principle of conservation of mechanical energy: Bernouilli's equation.

SECOND PARTIAL

Topic 8: Wave movement. Mechanical waves

38. Definition of wave. The wave function.
39. Types of waves.
40. Wave speed. The wave equation.
41. Harmonic waves.
42. Waves and Barriers.
43. Principle of superposition of waves.
44. Interference of harmonic waves.
45. Standing waves.

Topic 9: Electromagnetic waves. Properties of light

46. Electromagnetic waves. Electromagnetic spectrum.
47. Light spectra.
48. Light sources. Absorption, dispersion and stimulated emission.
49. Light propagation. Principles of Huygens and Fermat.
50. Reflection and refraction.
51. Interference and diffraction phenomena

Topic 10: Electric field

52. Electric charge.
53. Conductors and insulators.
54. Coulomb's Law.
55. The electric field.
56. Electric field lines.
57. Movement of point loads in electric fields.
58. Electric dipoles.
59. Electric flow.
60. Gauss's Law. Applications for electric field calculation.
61. Load and field on the surface of conductors.

Topic 11: Electric Potential and Electrostatic Energy

62. Electrostatic potential energy. Electric potential.
63. Potential and electric field lines.
64. Potential due to point load systems.
65. Determination of the electric field from the potential. General relationship between the field and potential.
66. Calculation of the potential for continuous load distributions.
67. Equipotential surfaces. Dielectric breakdown.
68. Capacitors.
69. Electrical energy storage.
70. Dielectrics.

Topic 12: Electric Current and Direct Current Circuits

71. Electric current and movement of charges.
72. Ohm's Law and Resistance.
73. Electric power and electric power.
74. Electromotive force in a circuit.
75. Series and parallel combinations of resistors.

Topic 13: Magnetic field. Magnetic field sources. Electromagnetic induction

76. Magnets and magnetic poles.
77. Force exerted by a magnetic field.
78. Movement of a point charge in a magnetic field.
79. Magnetic field created by a moving point charge.
80. Magnetic field created by electric currents: Biot and Savart's law.
81. Ampère's Law.
82. Atomic magnetic moments.
83. Magnetic flux.
84. Induced electromotive force and Faraday's law.
85. Lenz's Law.

5. COMPETENCIES

General

CG1	Use concepts from basic and technological subjects that enable autonomous learning of new methods and theories and the ability to address new situations.

Specific

CE2	Use basic concepts concerning the general laws of mechanics, fields and waves, and electromagnetism, and apply them to the solution of engineering problems.
CE2-F1	Distinguish between scalar, vector and tensor quantities
CE2-F2	Solve fluid statics problems
CE2-F3	Calculate electrical circuits and their components
CE2-F4	Explain the concept of magnetic field.
CE2-F5	Recall the macroscopic electromagnetic properties of a material.
CE2-F6	Describe the fundamentals of physical optics and the operation of basic optical instruments.

Transversal

CT1	Demonstrate capacity for analysis and synthesis
CT7	Work in a team, demonstrating interpersonal skills
CT10	Integrate acquired knowledge and apply it to solving real problems.
CT11	Learning autonomously

6. WORKING HOURS AND DISTRIBUTION BY ACTIVITY

Activity	Face-to-face (hours)	Freelance work (hours)	Credits
Theoretical classes	60	65	5
Seminars	15	20	1,4
Tutorials/Directed Work	7	10,5	0,7
Laboratories	12	9	0,84
Preparation of papers and exams	10	16,5	1,06
Total	**104**	**121**	**9**

7. METHODOLOGY

1. Face-to-face theory classes: At the beginning of each topic, the content, order and main objectives of said topic will be presented. At the end of each topic, a brief summary of the most relevant content will be made and new objectives will be set that will allow the interrelation of content already studied with that of the rest of the subject and other related subjects. Part of the recommended bibliography and the support material that is deposited on the virtual campus for the development of the teaching activities of this subject will be in English.

2. Face-to-face problem classes: the student will be proposed a list of problems/exercises with the aim of trying to solve them prior to the face-to-face classes, where their resolution will be carried out. In addition, the student will be proposed the presentation in class of the resolution of some problems/exercises, debating the resolution procedure, the result and the meaning of the latter.

3. Tutorials: they will be dedicated to problem solving by students and in small groups. The teacher will tutor and supervise the work of the students.

4. Directed activities: they will be aimed at promoting the development of self-employment. The student (or group of students) will have to solve several exercises in non-face-to-face hours.

5. Laboratory practices: they will enable students to learn the scientific method. By carrying out and analysing certain experiments, they will have to verify whether the initial hypotheses are true. In addition, they will learn to deal mathematically with the mistakes made in experimentation. The necessary calculation will preferably be carried out using scientific software (Excel, Origin or similar). Some of these activities will be carried out in English. Before the completion of the first laboratory of the subject, the student must confirm in writing that he or she has read, understood and accepted the safety rules of the laboratory.

8. BIBLIOGRAPHY

Basic

1. Tipler, Paul A.; Mosca, Gene: "*Physics for Science and Technology*", 5th ed., Ed. Reverté (2005). There are currently two editions, one in 2 volumes and the other in 6 volumes.
2. Sears, F. W.; Zemansky, M. W.; Young, H. D.; Freedman, R. A.: "*Física universitaria I y II*", Pearson, Mexico, 2004.

Complementary

3. Serway, Raymond A.; Beichner, Robert J.: "*Physics*", Vol I and II, 5th ed., Ed. McGraw-Hill/Interamericana de México, 2001.
4. Giancoli, Douglas C: "*Physics for University Students*", Vol. I and II., Editorial Alhambra Mexicana.
5. Ling, S. J., Jeff, S. y Moebs, W.: "*University physics. Volume 1, 2 and 3*", Rice University, Houston, Texas, 2010. Acceso online: https://openstax.org/details/

9. EVALUATION

Attendance at laboratory practices will be mandatory.

The final grade will result from the weighted average of the assessable activities. However, in order to pass the subject it will be necessary to achieve the minimum grade established in each of them. If this requirement is not met, the final grade will be the weighted average obtained, with a maximum of 4.5 out of 10.

In order to carry out the overall assessment of the subject, the student must have participated in at least 70% of the face-to-face activities. The grades will be based on the absolute score out of 10 points and in accordance with the scale established in RD 1125/2003. The final grade will take into account the following percentages, which will be maintained in all calls:

1. WRITTEN EXAMS: 80%

The exams will consist of questions and problems on the contents taught during the course in theoretical classes and seminars.

2. DIRECTED ACTIVITIES: 10%

A work proposed and presented in writing will be valued, as well as the resolution of some problems posed in class, and carried out both in groups and individually.

3. LABORATORIES: 10%

It is essential to obtain a minimum grade of 5.0 in the evaluation of the Laboratory Practices.

Some of these activities will be evaluated in English. In the laboratory practices, the corresponding report will be delivered, and in some cases, the calculation file developed by the student in the preparation of the results.

Students who have completed the internship in previous years will have the option of requesting the non-repetition of the internship as long as no more than 2 years have elapsed since they carried out these internships.

An exam will be held at the end of each semester to evaluate the subject of each of the two partial exams. In addition, a final exam will be held in both the ordinary and extraordinary calls.

Those students who have passed the two semesters may pass the subject in partial terms without having to take the final exam (see the note on compensable semesters). Otherwise, the final exam of the ordinary or extraordinary call must be passed.

Compensable: grades between 4 and 5 (4 ≤ grade < 5) obtained in the midterm exams will be considered compensable. The two semesters will be considered passed if in one partial a compensable grade is obtained and in the other a grade that added to the compensable partial gives a result greater than or equal to 10.

Approved partials (grade**≥ 5**) **and compensable will be kept for the convocation**of the final exams. That is, a student who has a partial pass or compensable may, if he or she wishes, take the exam only in the partial failed in the final exam. The compensable semesters will be saved for the final calls, taking into account that in order to pass the subject it is necessary to meet the requirement of the previous point.

The grades of the activities planned for the evaluation of the subject (midterm exams, laboratories, delivery of problems, etc.) will be communicated to students sufficiently in advance before the final exam, so that they can adequately plan the study of this or other subjects. In any case, the minimum period of seven days between the publication of the grades and the date of the final exam of the subject will be respected.

ACTIVITY PLANNING - TIMELINE

TOPIC	ACTIVITY	HOURS	GROUPS	HOME	END
1: Unit and Vector Systems **2: Cinematics. Dynamics of a particle. Newton's Laws**	Classes Theory and problems	10	1	1st Week	4th Week
	Scheduled Tutoring	1	1		
3: Work and energy **4: Oscillatory Movement**	Classes Theory and problems	12,5	1	5th Week	Week 9
	Scheduled Tutoring	1	1		
5: Particle System I: Linear Momentum and Collisions **6: Particle System II: Angular Momentum and Rotation**	Classes Theory and problems	10	1	10th Week	13th Week
	Scheduled Tutoring	2	1		
7: Fluids	Classes Theory and problems	5	1	Week 14	Week 15
8: Wave movement. Mechanical waves **9: Electromagnetic waves. Properties of light.**	Classes Theory and problems	7,5	1	16th Week	18th Week
	Scheduled Tutoring	1	1		
10: Electric field **11: Electric Potential and Electrostatic Energy** **12: Electric Current and Direct Current Circuits**	Classes Theory and problems	17,5	1	19th Week	Week 25
	Scheduled Tutoring	1	1		

13: Magnetic field. Magnetic field sources. Electromagnetic induction	Classes Theory and problems	12,5	1	26th Week	Week 30
	Scheduled Tutoring	1	1		

* The scheduling of tutorials depends on the complete planning of the course.

SUMMARY OF ACTIVITIES

TEACHING ACTIVITY	ASSOCIATED COMPETENCIES	TEACHER ACTIVITY	STUDENT ACTIVITY	EVALUATION PROCEDURE	P	NP	TOTAL	C
Theory classes	CG1 CE2-F1, CE2-F4, CE2-F5, CE2-F6	Presentation of theoretical concepts.	Note-taking	Grading of written answers to questions related to the theoretical concepts explained	60	65	125	
Seminars	CE2 CE2-F2 CE2-F3	Application of theory to the resolution of exercises and problems.	Note-taking. Performing exercises. Formulation of questions and doubts.	Grading of the answers (approach and result) made in writing for the resolution of practical exercises and numerical problems	15	20	35	
Tutorials/Directed Activities	CT1, CT7, CT10, CT11	Help the student to direct their study with bibliographic explanations and recommendations. Preparation and proposal of works	Consult the teacher about the conceptual and methodological difficulties encountered when studying the subject. Written preparation of individual works.	Student participation and assessment of the work.	7	10,5	17,5	**10%**
Laboratories	CT1, CT7	Explanation of the experimental methodology and analysis and presentation of scientific results.	Data collection and analysis during laboratory sessions. Preparation of reports. Specific laboratory examination.	Qualification of laboratory memories. Lab Exam Score	12	9	21	**10%**
Exams	CT1, CT10	Proposal, monitoring and correction of the exam. Student Rating	Preparation and realization.		10	16,5	26,5	**80%**

P: Face-to-face activities

NP: Non-face-to-face activities (self-employment)

C: Qualification