Bachelor´s Degree in Chemistry

Subject Guide

1. Information about the subject

SUBJECT	General Physics I		**CODE**	GQUIMI01-1-003
EDUCATIONAL OFFER	Bachelor´s Degree in Chemistry	**CENTER**	Facultad de Química	
TYPE	Core	**Nº TOTAL CREDITS**	6.0	
PERIOD	First Semester	**LANGUAGE**	Spanish English	
COORDINATORS/ES		**EMAIL**		
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LECTURERS		**EMAIL**		
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2. Context

As a part of the Physics Curriculum of the Basics Module, the contents of the Course deal with Mechanics and Waves. It is included in the first semester of the first year. A basic understanding of the essentials of the relevant physical phenomena and properties of matter will be pursued. The knowledge gained will be used in other specific subjects. **It is mandatory to pass this course to follow the subjects related to Physical Chemistry within the Fundamental Module**.

The Course is both of theoretical and experimental nature. Among its objectives, let us emphasise the following: a) Homogenise, complete and further develop the previous knowledge on Physical Science that the students may already have; b) Allow the students to get to know the main concepts, laws and results that are inherent to Mechanics, while being capable of applying them in different situations; c) Allow the students to acquire the necessary skills and abilities to address more advanced and specific Chemistry issues.

Roberto Iglesias (Department of Physics, Area of Applied Physics) will be the responsible person for all the activities and contents included in the Course. He can be found in his office located at the Faculty of Science, Llamaquique Campus, Federico García Lorca, 18, Oviedo.

3. Requirements

There are no mandatory specific requirements, although it is necessary to be acquainted with the most basic phenomena, concepts, laws and results in Physics, corresponding to the contents of the Physics courses followed by the students while in high school, and specially the chapters on Mechanics and Waves. Additionally, it is necessary to master essential mathematical concepts (Algebra, Geometry, Trigonometry) and be fluent with and good at mathematical operations, as well as to understand the concepts and know the elemental techniques of differential and integral calculus.

4. Competencies and learning results

General skills:

- Show analytical and synthetical skills (CG-1).
- Effective problem solving (CG-2).
- Suitable information management (CG-6).
- Correct spoken and written English (CG-8).
- Ability to learn autonomously (CG-9).
- Ability to develop a critical thinking (CG-17).
- Team-working skills (CG-18).

Specific skills - Know-how:

- Relate macroscopic properties to individual atomic and molecular properties (CE-2).
- Identify the main features of the different states of matter as well as the theories used to describe them (CE-4).

Specific skills - Abilities:

- Solve qualitative and quantitative problems by means of previously developed models (CE-20).
- Implement best scientific experimental and measurement practices (CE-23).
- Plan, design, and perform practical investigations, moving from the problem-discovery stage to the assessment and evaluation of the results and findings (CE-28).
- Explain data originated in laboratory observations and measurements as a function of their meaning and the theory they are supported by (CE-30).
- Perform uncertainty calculations and analyses characterised by a proper usage of magnitudes and units (CE-35).
- Write down, present and defend scientific reports, both in spoken and written form, before an audience (CE-36).

The aforementioned skills are reflected on the following learning process results:

1. Prepare and present a correct report, both in spoken and written form. Following each laboratory sessions that will be undertaken during the Course, the students will prepare and present a report in written form for each one of the experiments performed. As part of the transversal activities proposed, students will read a Physics-related educational book to subsequently fill in a summary report that will be presented in spoken form before their classmates and the faculty. Additionally, as a team-work assignment, they will have to write down a report on a subject proposed by the teaching staff. The report will be summarised in a poster that the students will present and defend before their classmates.
2. Formulate and solve problems that fall within the scope of Physics. During the group tutorial sessions, problems will be proposed. The student should solve them in a place other than the lecture hall, either individually or in a team. On top of that, the problems included in the exams taken during the Course will allow assessing the adequacy of the learning results to the proposed skills.
3. Show and make proper use of the basic scientific knowledge gained during the Course. The assessment of this particular learning outcome will be done via the exams and the participation of students in seminars and group tutorial sessions.
4. Use the basic terminology of Physics with correction. Express ideas with the precision required in the scientific world, while establishing relationships among diverse concepts. This learning outcome will be assessed via exam taking.
5. Use the laboratory equipment and apply the basic safety regulations to work in the laboratory. The experimental sessions included in the Course are designed to assess the adequacy of the learning outcome to the assigned skills.

Apply basic laboratory techniques that include the necessary calculations, while at the same time suitably expressing the results. The assessment of this outcome derives from the realization of the lab experiments, as well as from the use of a notebook that shows every observation taken during the practical sessions.

5. Contents

5.1. Theoretical topics. The theoretical contents that will be studied during this Course are grouped in nine chapters, sectioned as given in what follows. The approximate number of basics lecture hours dedicated to each chapter is also indicated.

Chapter 1. Introduction: units; motion along a straight line; vector calculus. [4h]

1. Dimensions of the physical magnitudes; systems of units.
2. Straight-line motion: position, velocity and acceleration; displacement travelled.
3. Vector calculus: vectors, vector operations; scalar product, vector product.

Chapter 2. Motion in space. [3h]

1. Reference systems; position vector and coordinates of a point.
2. Motion in space: displacement, velocity, acceleration; intrinsic components of acceleration.
3. Motion with constant acceleration.
4. Circular motion; angular description: angular velocity, angular acceleration.

Chapter 3. Newton's laws. Applications. [4h]

1. Forces; principle of superposition.

2. Newton’s laws: law of inertia; fundamental law of Dynamics; law of action-reaction.

3. Applications: equations of equilibrium and motion.

4. Important forces: weight, elastic force on a spring, normal reaction on a surface or a curve, tension on a string, friction forces, gravitational forces, electric forces, molecular forces.

Chapter 4. Work and energy. [4h]

1. Work done by a constant force in a straight-line displacement; properties. Power.

2. Kinetic energy theorem.

3. Generalization: work done by a variable force in a straight-line displacement; work done by a force during a displacement along a curved path. Work-energy theorem.

4. Conservative forces, potential energy; important examples.

5. Law of conservation of mechanical energy.

6. Energy diagrams for the straight-line motion.

Chapter 5. Systems of particles. [4h]

1. Systems of particles. External forces, internal forces.
2. Linear momentum; law of conservation.
3. Torque with regards to a point.
4. Angular momentum with regards to point; law of conservation.
5. Centre of mass; equation of motion of the CDM.
5. Kinetic energy; translational kinetic energy and internal kinetic energy.
7. Conservation of the total energy. External energy. Internal energy.
8. Two-body collisions.

Chapter 6. Dynamics of rotational motion. [3h]

1. The rigid body. Motion of a rigid body: translation, rotation.
2. Rotational motion about a fixed axis; rotational kinetic energy.
3. Angular momentum of the rigid body; equation of rotation.
4. Properties of the moment of inertia.
5. Combined translation and rotation.

Chapter 7. Oscillations. [5h]

1. Oscillatory motion; general features.
2. Simple harmonic motion; energy and force in a SHM.
3. Examples of mechanical oscillators: elastic oscillators, penduli.
4. Molecular vibrations.
5. Damped oscillations.
6. Forced oscillations; resonance.

Chapter 8. Motion of a fluid. [5h]

1. Fluids; model of a continuum.
2. Forces in a fluid; pressure.
3. Fluid statics; consequences and applications.
4. Motion of a fluid. Conservation of mass: the continuity equation; conservation of energy: Bernoulli’s law.

5. Applications.

6. Viscosity. Turbulence.

Chapter 9. Waves. [4h]

1. Mechanical waves; transverse and longitudinal waves.

2. Harmonic waves; energy of a harmonic wave.

3. The wave equation; superposition of waves.

4. Examples of mechanical waves: waves on a string, Sound.

5. Wave interference.

6. Standing waves.

5.2. Laboratory session topics. Three two-hour sessions will take place in the laboratory.

Session 1. Uncertainties in experimental measurements. Calculate the volumes of certain bodies by taking measurements via the Vernier caliper.

Session 2. Elastic force on a spring. Hooke's law.

Session 3. Wave interference. Standing waves on a string.

6. Methodology and working plan

The fulfilment of the specific objectives planned requires the contents of the Course to be exposed in the basics lectures, the problem-solving lectures, the group tutorial sessions and the laboratory sessions. Additionally, the Course is integrated in some of the joint activities that have been scheduled.

During the *Basics* (or theoretical) *lectures (CE)* the lecturer will first present the structure of each chapter and indicate its relationship to the chapters that have been studied previously. In a systematic and coherent way, he/she will expound on its theoretical contents via an oral presentation that will make use of the blackboard and auxiliary projectors. Additionally, he/she will solve some questions and problems in order to strengthen the theoretical understanding and the knowledge of the possible applications by the students.

Problem-solving lectures (PA) are dedicated to the analysis and specific application of the theoretical knowledge acquired during the Basics lectures. Questions and problems proposed beforehand will be solved with the support and orientation of the lecturer.

Well in advance of the *Group tutorial sessions (TG),* the students will be provided with the statements of short-answer questions and problems that they should try to solve individually or collectively before the session. In the class time the student will present the exercises that had been proposed earlier and the lecturer will clarify the doubts and difficulties that students may have found in their attempt to solve the assigned tasks. During the TG the lecturer will clarify the questions from the students, stemming from both Basics and Problem-solving lectures. On top of that, the aforementioned tasks (short-answer questions and problems) previously assigned to them will be presented during these sessions.

In the *Laboratory sessions (PL)*, the students will carry out simple experiments to get acquainted with the handling of measurement apparatuses, simultaneously learning basic experimental data acquisition and analysis techniques, as well as applying the knowledge they have acquired during the Course. Every student will write down in his laboratory notebook, which will always be available to the lecturer, all the observations and measurements undertaken. With them, and following the instructions received, he/she will work out and present a report at the end of the Course.

Other activities (OA) are devoted to promote joint activities with the other subjects of the semester. The students are expected to attend the reading workshops or interdisciplinary seminars, following the planning and coordination agreed by the teaching staff.

The total academic load is shown in the following table:

CATEGORIES		Time	Total
On-campus	Basics lectures	36	60
	Problem-solving lectures	7	
	Laboratory sessions	6	
	Group tutorials	4	
	Other activities	4	
	Assessment sessions	3	
Off-campus	Team work	15	90
	Individual work	75	
	Total	150	150

7. Evaluation of the student's learning results

The progress of the students according to the original planning is assessed in agreement with the following table, where the evaluation criteria and tools are given in detail, as well as the weight of each category, both for the regular and make-up assessment:

Category	**Criteria**	**Tool**	**Weight (%)**
A1. Theoretical content knowledge and skills.	Answer theory questions and solve problems that put such content to practical use	Written exams.	70
A2. Laboratory sessions.	Attendance and performance in the laboratory, write up an experimental report	Attendance control, experimental report and notes taken by the lecturer.	15
A3. Participation in TG and OA.	Attendance and active participation. Regarding OA, follow their syllabus.	Attendance control, notes by the lecturer and OA syllabus	15

- The minimum global score needed to pass the Course is 5 out of 10 points. However, **a score of at least 4 out of 10 points is required in each of the three assessment categories**.

- The written exam will allow testing the skills accomplished on the contents taught in the CE and the applications worked out in PA and TG. **Two midterm independent exams and one final exam** dealing with the full contents of the course have been scheduled. The content of the **optional midterm exams** will cover several chapters from the course programme and will be fixed by the lecturer. The second midterm exam will take place simultaneously with the final exam. Only the students that scored at least 4 out of 10 points in the first midterm exam will be allowed to take the second one.

- The assessment of PL will reward the attendance and attitude in the laboratory (50%) and the report delivered (50%).

- A3 will recognize the TGs (70%) —attendance and active participation— and the work done in OA (30%).

- **Activity make-up:** The students will perform written exams during the make-up assessment sessions, either to improve their grades on those categories in which the minimum required has not been achieved or to try to reach the minimum global score.

- **A1:** A unique written exam composed of theory and problem content.
- **A2:** Questions on the laboratory experiments performed and report on a case study. Maximum score: 5 points.
- **A3:** Solve a certain number of questions as the ones posed in TG. Maximum score: 5 points.

8. Resources, bibliography and complementary documentation

Recommended basic bibliography:

- *University Physics*; Hugh D. Young and Roger A. Freedman. Addison Wesley, eds. (aka “Sears-Zemansky”)
- *Physics for scientists and engineers*; Paul A. Tipler and Gene Mosca. Reverté, eds.

The first volume of any of these two books fully covers the program of the Course.

Ancillary bibliography:

- *Physics*; M. Alonso and Edward J. Finn. Addison Wesley, Eds.
- *Physics for scientists and engineers*; Raymond A. Serway and John W. Jewett. Thomson, Eds.
- *Principles of Physics for Scientists and Engineers*; H. A. Radi, J. O. Rasmussen. Springer, Eds.

Generally speaking, every theory or problems and questions book on General Physics at the university level is useful to consult and expand on the Course.

Either personally or via the web sites hosted by the University of Oviedo, the students will obtain extra materials, specifically prepared for them to follow the Course, such as Basics lectures (CE) summaries, PL tutorials, and problem sheets (statements and, sometimes, their solutions) and questions for PA and TG, as well as for individual homeworking.