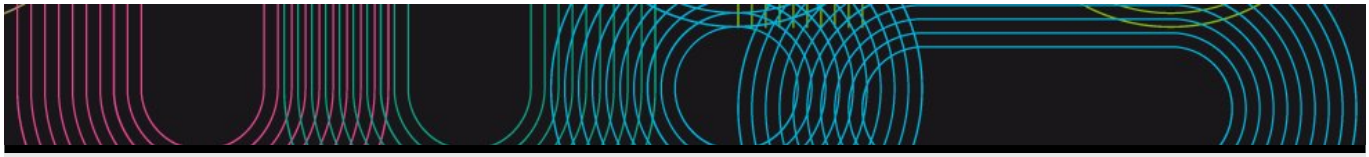

IDENTIFYING DATA				
Physics: Physics II				
Subject	Physics: Physics II			
Code	P52G382V01202			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Eiras Barca, Jorge			
Lecturers	Eiras Barca, Jorge Vázquez Carpentier, Alicia			
E-mail	jeiras@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The fundamental objectives shared by both this subject and its predecessor Physical I are, on the one hand, the consolidation, with the appropriate conceptual and formal rigor, of previously acquired knowledge. On the other hand, the establishment of the necessary bases for the study of other disciplines, either basic or fundamental. All this in such a way shows that the final objective is not the mere theoretical speculation but the application of the acquired knowledge to the technology, through the appropriate models and physical-mathematical schemes. The necessary skills and abilities will be developed for the resolution of technical problems related to Physics, practicing the analytical-deductive methodology of this science. The program of the Physics II subject of the Bachelor Degree in Mechanical Engineering is divided into two large blocks: Thermodynamics and Electricity and Magnetism, which will be developed in nine chapters as detailed in the contents section. This subject is key to understand subjects that will be studied later such as Thermodynamics and Heat Transfer, Thermal Engineering I, Foundations of Electrical Engineering or Electronic Technology. The second block is articulated in seven chapters that will follow a quasi-chronological development of classical electromagnetism. As in this second block, the first block will develop the classical formulation of thermodynamics summarized in two sections.			

Training and Learning Results	
Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
C2	Understanding and mastering the basics of the general laws of mechanics, thermodynamics, waves and electromagnetic fields, and their application for solving engineering problems.
D2	Problems resolution.
D9	Apply knowledge.
D10	Self learning and work.

Expected results from this subject	Training and Learning Results		
To understand the basic concepts of the general laws of electromagnetism and thermodynamics.	B3	C2	D2 D9 D10
To know the basic instrumentation to measure physical magnitudes.	B3	C2	D2 D9 D10

To know the basic techniques of evaluation of experimental data.	B3	C2	D2 D9 D10
To develop practical solutions to elementary technical problems of engineering in the fields of electromagnetism and thermodynamics.	B3	C2	D2 D9 D10
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.- Knowledge and understanding of the scientific and mathematical principles that underlie its engineering branch. Adequate.	B3	C2	
ENAEE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO2.- A systematic understanding of the concepts and key aspects of its engineering branch. Adequate.		C2	D2 D9
ENAEE learning outcome: RESEARCH AND INNOVATION: LO11.- The capacity to design and realize experiments, interpret the data and take out conclusions. Basic.		C2	D9

Contents

Topic	
1. FIRST PRINCIPLE OF THERMODYNAMICS	1.1. Introduction. Temperature and thermal equilibrium. Calorimetry. Changes of state and ideal gas. Equations of state. 1.2. Thermodynamic systems. 1.3. Work done in compression and expasion processes. 1.4. First law of thermodynamics. 1.5. Thermodynamic transformations. 1.6. Thermodynamics of ideal gases.
2. SECOND PRINCIPLE OF THERMODYNAMICS	2.1. Thermal machines. 2.2. The second law of thermodynamics. 2.3. Thermal cycles. 2.4. The Carnot cycle. 2.5. Entropy and physical interpretation. 2.6. Nerst's theorem. The third law of thermodynamics. 2.7. Perpetual motion of first and second species.
3. ELECTRIC FIELD I	3.1. Electric charge. Nature and units. Conductive and insulating materials. 3.2. Electrostatic forces. Coulomb's law. Electric field: Definition and units. Electric field originated by point charges. Electric field caused by charge distributions. 3.3. Electrostatic flow. Application of Gauss's theorem to the determination of electrostatic fields in typical configurations. 3.4. Electrostatic force work. Electrostatic potential energy. Electric potential: Definition and units. Equipotential surfaces. 3.5. Electric potential originated by point charges or charge distributions. Electric field and potential in conductors and insulators. Case studies of typical configurations.
4. ELECTRIC FIELD II	4.1. Electric field vectors, polarization and electric displacement. Relative permittivity. 4.2 Electrostatic capacitance. Definition and units. Capacitors. 4.3 Capacitance of capacitors. Particular analysis of the plane, cylindrical and spherical cases. 4.4 Electrostatic energy.
5. ELECTRIC CURRENT	5.1. Charge transport under potential differences. Current intensity and current density. Definition and units. 5.2. Conductance and resistivity. Conductance and resistance. Definition and units. Ohm's law. 5.3. Electromotive force and circuits. Kirchoff's laws in resistive circuits. 5.4. Energy and power in electrical circuits.
6. MAGNETIC FIELD I	6.1 Introduction to magnetism. Oersted's experience. Sources of the magnetic field. Magnetic induction field originated by a moving charge and a current element. Biot-Savart law. 6.2. Calculation of the magnetic induction field caused by simple configurations of current: Rectilinear conductor of great length at a given distance and circular current loop at the points of its axis. 6.3. Mutual force between parallel rectilinear conductors. Definition of the Ampere in the International System. 6.4. Ampere's law. Applications: Very long solenoid and toroidal solenoid. 6.5. Magnetic fields in material media. Magnetic susceptibility and magnetization vectors and magnetic field strength. 6.6. Different types of materials according to the value of their magnetic susceptibility.

7. MAGNETIC FIELD II	7.1. Lorentz force. 7.2. Analysis of particular cases of motion of charges in magnetic fields. Applications. 7.3. Magnetic force on current-carrying conductors. Moment of forces on current loops. Dipole magnetic torque of a loop. 7.4. Applications: DC engine, electromagnetic pump and Hall effect.
8. ELECTROMAGNETIC INDUCTION	8.1. Electromotive force induced by magnetic field flux variations. Experimental introduction. Faraday-Henry's law of induction and Lenz's law. 8.2. Electromotive force induced by the movement of currents within magnetic fields. Applications: Dynamos and alternators. 8.3. Mutual induction between magnetic elements. Self-induction. Coefficients of self-induction and mutual induction. Units. 8.4. Energy stored by the magnetic field. Formulation in terms of magnetic fluxes and intensities. Applications.
9. ELECTROMAGNETIC WAVES	9.1. Review of Ampère's law. 9.2. Maxwell's equations. 9.3. Poynting vector. 9.4. Electromagnetic plane wave. Properties.
LABORATORY SESSIONS	P1.- P-V relationship in a closed gas. P2.- Instruments and methods of electrical measurements. P3.- Capacitors. P4.- Magnetic field I. P5.- Electromagnetic induction. Problem Solving Session I. Problem Solving Session II.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Seminars	14	0	14
Laboratory practical	14	14	28
Problem solving	15	5	20
Essay questions exam	2	0	2
Essay questions exam	2	0	2
Objective questions exam	3	0	3
Essay	0	5	5
Objective questions exam	3	0	3
Objective questions exam	3	0	3

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	The lecturer will present the contents of each unit throughout theoretical classes. Presentations will be projected and the blackboard will be used simultaneously. Occasionally, computer media will be used. The copies of the projected material will be available to the student, to facilitate the taking of notes and the follow-up of the sessions. Students will also be able to consult basic texts for the follow-up of the course. Participation will be encouraged with questions, motivational techniques such as intentional errors, incomplete solutions, etc., Each session will have a duration of 1h and involves a personalized attention in groups.
Seminars	Directed activities will be planned in the classroom, some of them will be carried out individually by each student and others in groups, in order to encourage collaborative groups, to promote collaborative learning and personalized attention during the activities. Basically, the aim will be to solve problems related to the contents presented in the lecture sessions, so that a teaching methodology of problem-based learning is followed. The student will have to solve exercises and problems which will be corrected and evaluated by the lecturer. As in the master sessions, the use of blackboard and occasionally computer media is considered.

Laboratory practical	In these practical classes, the material available in the center's laboratory will be used. For some of the sessions it may be necessary to use MATLAB (or, alternatively and at the student's choice, Python) to handle a series of tools for testing concepts introduced in the theoretical sessions. With regard to the practical laboratory practical classes, the student must take into account the following directives, which will be mandatory: -The practical sessions are compulsory and of face-to-face character. -The student must hand in the corresponding report for each of the programmed laboratory practical sessions. It is considered the case that the report is handed in blank with the name or names of the students (it is considered as delivered and with a grade of 0). -The students who do not meet either of the above two requirements will not be able to pass the laboratory. -The time of delivery of the practices will be established by the lecturer in each session. session.
Problem solving	Problems related to the proposed laboratory practical sessions. These are proposed so that the student can better understand and relate the theoretical concepts of the subject with their practical application. The student will have to solve these exercises that will be corrected and graded by the lecturer.

Personalized assistance

Methodologies	Description
Seminars	In the field of tutorial action, academic tutoring actions are distinguished, as well as personalized tutoring where students will have at their disposal hours of tutorials in which they can consult any doubt related to the contents, organization or planning of the subject. The tutorials can be individualized, but group tutorials will be encouraged for the resolution of problems related to the contents of the course. In the personalized tutorials, each student, individually, will be able to discuss with the lecturer any problem that is preventing him/her from following the course properly, in order to find some kind of solution between both of them. The lecturers of the subject will personally attend to the doubts and queries of the students, both in person, according to the schedule that will be published on the web page of the center, and through e-mail or other telematic means (use of the virtual office by appointment, videoconference, use of Moovi forums, etc.).

Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practical	Evaluation of the laboratory reports (EP).	15	B3	C2	D9 D10
Essay questions exam	First exam of the continuous evaluation program (P1).	15	B3	C2	D2 D9 D10
Essay questions exam	Second exam of the continuous evaluation pogram (P2).	15	B3	C2	D2 D9
Objective questions exam	Final exam of the continuous evaluation program (FE).	40	B3	C2	D2 D9 D10
Essay	Complementary activity (CA).	15			D10
Objective questions exam	Recovery - Ordinary Exam.	100	B3	C2	D2 D9 D10
Objective questions exam	Recovery - Extraordinary Exam.	100	B3	C2	D2 D9 D10

Other comments on the Evaluation

The ongoing evaluation techniques for this course will be the following:

Continuous evaluation tests (P1 and P2): Two evaluation tests will be carried out throughout the four-month period. The tests will be carried out in the theoretical classes as proposed by the lecturers. The completion of the two tests will be mandatory and required to pass the course.

Evaluation of laboratory practices (EP): Throughout the term, in certain sessions of practices problems or exercises will be posed for resolution by the students (individually or in groups) and subsequent delivery to the lecturer, who will evaluate them according to the criteria that will have been previously communicated to the students. The undelivered reports will count with a zero at the time of averaging. The grade of this component will be the average of the grades of all the reports handed in. Some practices will be evaluated through the completion of small evaluable questionnaires related to the work done during the practice and its subsequent analysis.

Complementary activities (CA): During the course of the course, activities (problems, complementary works, etc.) will be proposed so that the students can solve them autonomously and/or present them in class. Both the resolution and the explanation of the resolution process will be valued, as well as the skills of oral expression, comprehension and public exposition.

Final exam of continuous evaluation (FE): There will be a final exam that will cover all the contents of the course, both theoretical and practical. It is required to achieve a minimum grade of 4 points out of 10 in each of the possible blocks of the subject in order to be eligible for a passing grade by continuous evaluation.

The student's final evaluation will be based on the sum of the score given to each of the above mentioned parts, being the continuous evaluation grade (CEG):

$CEG = 0.15 \cdot P1 + 0.15 \cdot P2 + 0.15 \cdot EP + 0.15 \cdot CA + 0.40 \cdot FE.$

Being:

P1 - First continuous evaluation test.

P2 - Second continuous evaluation test.

EP - Evaluation of practices.

CA - Complementary activities.

FE - Final continuous evaluation exam.

In addition, due to the fact that the subject matter of the course is divided into two well differentiated thematic blocks (Thermodynamics and Electromagnetism), a minimum grade of 4 will be required in each of the blocks in order to obtain an average. The percentage corresponding to each block in the ordinary and extraordinary exams will be determined by the proportion of hours of theory taught in each block. For this reason, the electromagnetism block will represent 85% of the final grade and the thermodynamics block will represent the remaining 15%.

Therefore, some minimum requirements and conditions will be demanded in some of the sections that guarantee the balance between all types of competences.

The student must take the ordinary exam of all the contents of the course, which will account for 100% of the grade, in the following cases:

A. Not having reached the minimum grade established in each of the blocks or in the final continuous evaluation test.

B. Obtaining a grade lower than 5 points out of 10 in the continuous evaluation grade. (CEG lower than 5).

The continuous evaluation grade of the student who fails to comply with assumption A, will be the minimum between CEG and 4 points.

Recovery plan of the final grade in first call:

Each and every student who has not passed the course during the continuous evaluation has the right to access a plan to recover the course.

The recovery plan consists of the right, already acquired, to take a new exam, called ordinary or first call, on the dates set, whose grade, if higher, will replace the one obtained previously and will count for all purposes in the calculation of the final grade.

It is understood that the grade obtained in the exam replaces, in case of being higher, the grade obtained through the continuous evaluation of the subject throughout the four-month period, replacing the aggregation of the grades of the practical tests, the continuous evaluation tests, the complementary activity and the continuous evaluation exam.

The requirement to pass each of the blocks of the subject (Electromagnetism and Thermodynamics), with a minimum grade of 4 in each of them, is maintained for the ordinary exam or first call.

Recovery plan of the final grade in the second call:

Each and every one of the students who have not passed the subject during the first call are again entitled to access a plan to recover the subject.

The recovery plan consists of the right, already acquired, to take a new exam, called extraordinary or second call, on the dates set, whose grade will replace the one obtained previously and will count for all purposes in the calculation of the final grade.

It is understood that the grade obtained in the exam replaces, in case of being higher, the grade obtained in the ordinary or first call exam.

The requirement to pass each of the blocks of the subject (Electromagnetism and Thermodynamics), with a minimum grade of 4 in each of them, is maintained for the extraordinary exam or second call.

Improvement plan for the final grade:

Each and every student can access a plan to improve their final grade.

The improvement plan consists of the right, already acquired, to take a new exam, coinciding with the ordinary exam or first call, on the dates set by the center. The new grade will replace the one obtained previously just if it is higher than the one already obtained, and will count for all purposes as the only reference in calculating the final grade.

Protocol for the detection of academic fraud:

Students are subject to the ethical commitment required for all students of the University of Vigo and military training centers. The actions of the faculty in case of detection of academic fraud will also be based on the following:

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity,** regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

Young H.D., Freedman R.A., **Física Universitaria, V1 y V2**, 13, Pearson Educación, 2013

De Juana J., **Física General (VOL. II)**, 2, Pearson Educación, 2007

Fernández J.L., Pérez-Amor M. J., **Guía para la resolución de problemas de electromagnetismo. Problemas resueltos.**, 1, Reverté, 2012

Fidalgo J. A. y Fernández M. R., **1000 Problemas de física general**, 8, Everest S. A., 2004

González F.A., **La Física en problemas**, 1, Tébar Flores, 2002

Pellicer J., Manzanares J.A., **100 problemas de Termodinámica**, 1, Alianza Editorial, 1996

Complementary Bibliography

Serway R. A., Jewett J. W., **Física para ciencias e ingeniería V1 y V2s**, 7, Cengage Learning, 2008

Tipler P., Mosca, B., **Física para la ciencia y la tecnología, V1 y V2**, 6, Reverté, 2010

Wangsness R. K., **Campos electromagnéticos**, 1, Limusa, 2001

Recommendations

Subjects that continue the syllabus

Electronic technology/P52G381V01301

Final Year Dissertation/P52G381V01991

Other comments

The Physics II course is a linking element between the knowledge acquired in previous stages of the degree and the knowledge to be assimilated in more advanced stages.

This discipline, of a fundamental nature, provides the conceptual basis necessary to continue, if necessary, the study of other subjects of other subjects of a similar nature and, in general, of those related subjects specific to the syllabus of the

corresponding degree. It is for this reason that in order to successfully take this subject the student must have:

1. Basic knowledge acquired in the subjects of Physics and Mathematics in previous courses of high school or equivalent (review is recommended).

2. Written and oral comprehension skills

3. Capacity for abstraction, basic calculation and synthesis of information.

4. Group work and group communication skills.

In addition, the student is reminded that the learning of Physics requires a progressive work methodology. So, in order to guarantee the success in this subject, the study of this subject should be kept up to date.