Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** .

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** First year

COURSE

27673 - Physical Basics of Engineering **Credits, ECTS:** 12

COURSE DESCRIPTION

In relation to the prerequisites of the subject, we would highlight:

1. To know and comprehensively apply the basic concepts of science and technology (chemical, physical, mathematical and technical principles) required in engineering at a baccalaureate (high school or A-levels) level.

2. To apply at a basic level some of the strategies of scientific methodology: locate, obtain, analyze and represent qualitative and quantitative information, and to interpret, evaluate and communicate the conclusions.

In the context of the undergraduate program, this course has the following objectives:

1. It is a basic subject, through which it is intended to learn and understand the basic principles and theories of Physics. Its contents and strategies, typical of the scientific method, must be complemented with the rest of the subjects of first year, especially with the subject of "Chemical Basics of Engineering", as well as all those subjects in the field of mathematics.

2. To acquire the knowledge and learning strategies that allow advancement in subsequent courses; in this sense, it is intended that the students reach the basic knowledge and competences which will be developed further in subjects that are common to all undergraduate engineering degrees in the 2nd year such as: "Material Science"," Thermal Engineering "," Industrial Electronics "," Applied Mechanics "...

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

C1: To develop the knowledge of basic concepts about the general laws of mechanics, thermodynamics, fields and waves and electromagnetism, and to be able to properly apply it for understanding problematic situations typical of engineering.

Learning Outcomes (C1):
- To know the concepts, laws and fundamental principles of basic physics.
- To distinguish the range of applicability of the concepts, laws and fundamental principles of basic physics.
- To apply the concepts, laws and fundamental principles of basic physics properly in different contexts.

C2: To use the procedural knowledge associated with scientific methodology in solving problematic situations in basic physics consistently, both experimental situations and hypothetical situations on paper: perform qualitative analysis, propose/articulate hypothesis, develop alternative strategies and analyze results.

Learning Outcomes (C2):
- To make observations and qualitatively analyze the problem.
- To issue reasoned hypotheses.
- To develop explanatory strategies.
- To solve problems.
- To analyze the obtained results.

C3: To work with information corresponding to processes related to basic physics, to analyze and express ideas correctly using verbal, mathematical and graphic language.

Learning Outcomes (C3):
- To search for and analyze information.
- To express ideas properly both written and orally.
- To use various symbol systems or forms of representation: text, formulas, tables, graphs and diagrams.

C4: To work as a part of a team to tackle cooperative tasks with colleagues in the context of physics: to elaborate proposals, to analyze the contribution of others, to discuss ideas and to carry out agreed tasks/actions.

Learning Outcomes (C4):
- To participate actively and to assume individual responsibility in the group.
- To collaborate using the instruments of group work.

C5: To adopt a favorable attitude towards learning the subject, being proactive, participative and with spirit of overcoming learning difficulties.

Learning Outcomes (C5):
- To show a responsible and committed attitude.
- To show willingness to learn.
- To use independent learning resources.

Theoretical and Practical Contents

KINEMATICS: We will define the essence of the position measurement of a point in the space and the concepts that define its movement, particularizing the study in the most common movements. Finally, we will show the relationship between magnitudes determined by two observers between which there is displacement, but no rotation.

DYNAMICS OF A SINGLE PARTICLE: We will begin by studying Newton's laws and their limits of application, detailing the forces that have special behavior. We will define the angular momentum of a particle, its conservation, work, kinetic energy, potential energy, and their relationship.

DYNAMICS OF A SYSTEM OF PARTICLES: We will extend the study of dynamics to systems of many particles, highlighting the differences and we will apply it to the case of collisions and explosions.

RIGID SOLID: After analyzing the general movement of a rigid solid, we will focus on the study of its rotation, starting with angular momentum, work and energy. We will study the rolling motion and finally we introduce the concepts of balance and statics.

THERMODYNAMICS: After introducing a series of definitions and basic ideas, and the definition of an ideal gas, we will address the concepts of heat and work, as well as that of internal energy, which will allow us to establish the first principle of thermodynamics, the application of which will be particularly analyzed in the case of closed ideal gas systems. Next, we will study the second principle of Thermodynamics and its different statements. We will study cyclical processes and the performance of heat engines and refrigerators.

ELECTROSTATICS: In this lesson, we will study the electrical properties of matter, as well as finding the mathematical model that explains electrical interaction. Then, in the absence of solutions from the previous model for certain problems, the concept of electric field will be introduced, as well as its applications, and the way of calculating it in any circumstance. Finally, we will address electrostatic processes, from the energy standpoint, through the concept of potential, which allows us to have an alternative resolution strategy to that of the use of the field concept, to solve problematic situations.

APPLICATIONS OF THE ELECTRIC FIELD: This lesson will help us apply the concepts seen in the previous topic (field, potential, electrical energy, etc.) to practical cases, from a technological point of view. We will introduce the concepts of capacitance and electric current. Finally, we will tackle the study of the study of electric circuits.

MAGNETIC FIELD: in this lesson, we will analyze the sources of magnetic fields (magnets and charges in movement), concluding that both are part of the same scheme. This will allow us to delve naturally in the 'magnetization of matter'. Finally, we will approach the study of a mathematical model that allows us to calculate magnetic fields under very specific conditions of symmetry (Ampère's Law).

ELECTROMAGNETIC INDUCTION: In previous lessons, we have only considered magnetic fields whose intensities does not vary over time. Here we approach the study and applications of magnetic fields that do vary with time. We will analyze in depth the causes of electromagnetic induction as well as the mathematical model (law of Faraday-Lenz) that describes the phenomenon of electromagnetic induction. We will analyze some applications of this phenomenon and we will finish by presenting Maxwell's laws.

WAVES: After introducing the essentials of simple harmonic motion, we will describe the basics of waves and their types, specific wave phenomena (interference, standing waves, and diffraction) and finally the Doppler effect.

During all these lessons, both theoretical and practical activities, will be carried out using the different teaching modalities, namely: Master Classes, Classroom Practices, Seminars and Laboratory Practices.

TEACHING METHODS

The set of aspects described above are framed within the teaching-learning model inherent to the European Higher Education Area (EHEA). A model in which one of the basic aspects is to promote non-attendance work, related to the tasks, in order to teach how to learn so that students can learn how to learn autonomously.

In this proposal, as it could not be otherwise, we have tried to establish an explicit and intentional relationship between the activities to be carried out in each teaching modality and the competencies to be achieved. In this sense, it is in the Master Classes and Classroom Practices that competences C1 and C3 will be addressed and worked on; in Seminars and Laboratory all the competences of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	60	14	30	16					
Horas de Actividad No Presencial del Alumno/a	70	40	54	16					

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Multiple choice test 20%
- Laboratories (reports and multiple choice tests) 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation will be a continuous assessment, and in order to pass, it will be necessary to obtain a minimum of 5 out of 10 points in the sum of the marks obtained in the written tests, seminars and laboratories.

A) Written tests: maximum 6 points. The course is organized around four blocks of differentiated contents of 1.5 points each:
- Block 1: single particle mechanics
- Block 2: mechanics of particle systems and thermodynamics
- Block 3: electric field and its applications
- Block 4: magnetic field, induction and waves

There will be 4 written tests:
- P1: knowledge on block 1 will be evaluated. It will be carried out during the first term, and will have a value of 1.5 points.

- P2: the knowledge on block 2 will be evaluated. It will take place during the examination period between the two terms, and will have a value of 1.5 points.
- P3: knowledge of block 3 will be evaluated. It will take place during the second term and will have a value of 1.5 points.
- P4: the knowledge of block 4 will be evaluated, plus the knowledge of blocks 1, 2 or 3 in which at least 0.6 points have not been obtained in the previous tests or that the student chooses to retake (in this case the mark obtained in previous tests will not be taken into account). The test will take place during the examination period corresponding to the ordinary call. Each block will be worth 1.5 points.

B) Seminars (maximum 2 points).
Students will work in groups and their work will be evaluated throughout the course. In each seminar session an exercise will be solved in group and the assessment will be carried out through tests. The final grade will be the average of the grades obtained in the tests after discarding the lowest grade that is not 0 due to an unjustified absence.
Attendance to the seminars is compulsory and absences will be taken into account in the following way:
• In case of having 1 or 2 justified absences they will not be taken into account in the final grade of the activity.
• In case of not taking a test or having an unexcused absence, the grade of the corresponding session will be 0 points.
• In case of having more than one unexcused absence or more than two excused absences throughout the course the final grade will be 0 points.

C) Laboratories (maximum 2 points). Students will work in groups and their work will be evaluated throughout the course. The first two sessions will be introductory, a further session will be devoted to an individual laboratory examination and in the rest of the sessions each group will deliver a report on the work done in the indicated deadline. The grade will be calculated as the weighted sum of the grade of the laboratory exam, the grade obtained in the introductory sessions and the weighted average of the laboratory reports.
Attendance to the laboratories is compulsory and absences will be taken into account as follows:
• In case of having 1 or 2 justified absences they will not be taken into account in the final grade of the activity.
• In case of not taking a test or having an unexcused absence, the grade of the corresponding session will be 0 points.
• In case of having more than one unexcused absence or more than two excused absences throughout the course the final grade will be 0 points.

Final grade of the course:
In order to pass it will be necessary to obtain at least 30% of the points in each block of the subject, in seminars and in laboratories. If this is the case, the final grade will be the sum of the grades obtained in the written tests, seminars and laboratories. Otherwise, the final grade will be a fail, with a maximum of 4.5 out of 10.

Withdrawal from the continuous evaluation (final evaluation option):
In order to withdraw from the continuous evaluation, it is enough for the student to take the written tests corresponding to all the blocks in the P4 test (ordinary exam). In this case, the final evaluation will consist of:
• Written test to be taken during the official exam period: maximum 6 points.
• Seminars (maximum 2 points) and Laboratories (maximum 2 points). Both activities will be evaluated throughout the course. See the details of the evaluation in the continuous evaluation section.
In order to pass, it will be necessary to obtain to obtain at least 30% of the points in each block of the subject, in seminars and in laboratories. If this is the case, the final grade will be the sum of the grades obtained in the written test, seminars and laboratories. Otherwise, the final grade will be a fail, with a maximum of 4.5 out of 10.

Renunciation of the ordinary call:
In order to obtain the NP (not presented) qualification, it will be enough not to take the written test P4.

In the event that the sanitary conditions prevent the realization of a classroom evaluation, an online modality will be activated and students will be informed immediately.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To pass, it will be necessary to obtain a minimum of 5 out of 10 points in the sum of the marks obtained in the written tests, seminars and laboratories. It will consist of two parts:

A) Written test P5: maximum 6 points. It will consist of four blocks of differentiated contents of 1.5 points each:
- Block 1: particle mechanics.
- Block 2: mechanics of particle systems and thermodynamics.
- Block 3: electric field and its applications.
- Block 4: magnetic field and induction and waves.

If in the written tests carried out during the course a grade equal or higher than 0.90 points is obtained in any block, that block is cleared for the P5 test. In this case, the grade is maintained in the extraordinary exam and it is not necessary to re-examine it in the P5 exam.

B) Seminars Test (maximum 2 points). It will consist of a written and an oral part. Questions will be proposed on the resolution of problems that have been worked on in the seminars.

C) Laboratories Test (maximum 2 points). It will consist of a written and an oral part. Questions on the methodology of work in the laboratory will be proposed, as well as other questions that have been worked on in the laboratories.

Students who, having taken the written test A) do not take the Seminars B) and/or Laboratories C) test will keep the grade obtained during the course in these last two teaching modalities (Seminars and Laboratories). Students who take the tests A), B) and/or C) will be graded according to the results obtained in these tests, regardless of the grades obtained during the course, which will not be maintained.

Final grade of the course:
In order to pass, it will be necessary to obtain at least 30% of the points in each block of the subject, in seminars and in laboratories. If this is the case, the final grade will be the sum of the marks obtained in the P5 test, the marks obtained in the written tests taken throughout the course, if applicable, and the seminar and laboratory test. Otherwise, the final grade will be a fail, with a maximum grade of 4.5 out of 10.

Renunciation of the extraordinary call:
In order to obtain the NP (not presented) qualification, it will be enough not to take the written test P5.

In the event that the sanitary conditions prevent the realization of a classroom evaluation, an online modality will be activated and students will be informed immediately.

MANDATORY MATERIALS

Exercise guide of the subject Physical Basics of Engineering

Laboratory guide of the subject Physical Basics of Engineering

BIBLIOGRAPHY

Basic bibliography

TIPLER P.A. y MOSCA G. Physics for Scientists and Engineers. (Editorial: Worth Pub).
SEARS, F.W. et al. University Pysics. (Pearson Education).
FISHBANE, P. M., GASIOROWICZ S., THORNTON S. T. Physics for Scientists and Engineers (Pearson Education).

Detailed bibliography

CHABAY, R. y SERWOOD, B., 2007. Matter & Interactions, Vol I y II, (John Wiley & Sons, Inc.).
HEWITT, P. G., SUCHOCKI, J., HEWITT, L., A., 2004, Conceptual Physical Science, (Pearson International Edition))

Journals

Web sites of interest

http://www.sc.ehu.es/sbweb/fisica3/
http://science.howstuffworks.com/
http://phet.colorado.edu/simulations/
http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
http://www.ehu.es/

OBSERVATIONS