Universidad Zaragoza

Academic Year/course: 2022/23

29502 - Fundamentals of Physics

Syllabus Information

Academic Year: 2022/23
Subject: 29502 - Fundamentals of Physics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 625 - Bachelor's Degree in Industrial Processes' Data Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject Type: Basic Education
Module:

1. General information

1.1. Aims of the course

Approaches and aims of this subject:

- Comprehension of the concepts and Physical laws that rule and explain the working of computer devices.
- Comprehension of the Electromagnetism laws, which are responsible for the physical behaviour of passive elements such as capacitors, resistors, coils, diodes and other basic elements that are part of a circuit.
- Comprehension of the different methods used to analyse electronic circuits, the behaviour of the different elements that are part of them and the responses produced by this circuits and each element itself.
- Comprehension of the operation and response of electronic devices working connected to sources of direct current (dc) or alternating current (ac).
- Comprehension of the Electromagnetic Waves, their reception and generation techniques, transport and attenuation.
- Study and comprehension of the electrical and magnetic properties of the different elements part of a circuit, taking into account their atomic, molecular and cristalline structure.
- Analysis of problems combining different aspects of the applied Physics to Electrostatics, Electrodynamics and Electromagnetism.
- Problem solving related to electric charge generation and transport, energy absorption by passive elements of a circuit, response of circuits and electromagnetic waves.
- Right use of the units of measurement and the order of magnitude of the different physics magnitudes that belong to the Electromagnetism and are applied to the analysis of devices and circuits used in the Information and Communication Technology.
- Right use of the basic methods of experimental measurement or simulation, and analysis, interpretation and presentation of the gathered data relating them to their corresponding magnitudes and Physics laws.
- Correct use of the bibliography available with a critic mind and focus, using a technical language with clear ideas and concepts in order to explain and debate about issues of the underlying Physics and knowledges related to it.
- Comprehension of the operation of hardware devices and the motive of their design, as well as, study of new materials taking into account the likelihood of new material proposals that could improve the operation of hardware devices, based on the comprehension that this university degree is a dynamic field in constant change.
- Capability of comprehension and description of wave phenomena that affect to Electromagnetic Waves.

This approaches and purposes are aligned with the Sustainable Development Goals from the 2030 Agenda for Sustainable Development, proposed by the United United Nations (https://sdgs.un.org/goals), in such a way that the learning outcomes from this subject provide skills and competences that would allow the students to contribute to some extent in its achievement.

Goal 9: Industry, Innovation and Infrastructure.

Goal 17: Partnerships for the Goals.

	Build resilient infrastructure, promote inclusive and sustainable

Goal 9:	industrialization and foster innovation
Target 9.5:	Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.
Target 9.b:	Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities.
Target 9.c:	Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020.
Goal 17:	**Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development**
Target 6:	Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism.
Target 7	Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.
Target 8:	Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology.
Target 18:	By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts.

1.2. Context and importance of this course in the degree

Fundamentals of Physics is a subject which purpose is to provide Students the fundamentals of Physics necessary to explain the operation of hardware devices used in Technology of Information and Communication, using mathematical equations that encode their response based on electromagnetic interactions and their limitations. It is a transverse subject to the degree of Engineering in Data and Industrial Processes, studied within the framework of subjects part of the module of Scientific Fundamentals. It is a first year, first semester, obligatory course with 6 ECTS credits.

1.3. Recommendations to take this course

It is highly recomended to students to have a good knowledge and mastery of the following concepts: Electricity, Magnetism, Vectorial Calculus and Integral and Differential Calculus, subjects already studied at high school level in Spain. Also, students should have knowledges of Linear Algebra and physical concepts related to Kinematics, Dynamics, Thermodynamics and Waves. It is highly recommended a good capability and skill in problem solving.

2. Learning goals

2.1. Competences

Those students, who have passed with success this subject, will have the competencies expected for an Engineer in Data and Industrial Processes that were written and elaborated by EUPLA and validated by the University of Zaragoza. These competences can be found in:

https://academico.unizar.es/sites/academico.unizar.es/files/archivos/ofiplan/memorias/grado/ingenieria/mv_164.pdf

Basic and General Competencies:

- CG03: Applying different techniques for data adquisition, management and processing in Engineering.
- CG05: Solving technological problems that could raise in the Engineering of Data and Industrial Processes.
- CB2: To apply their knowledges to their job or vocation in a professional way, having the competencies showed by means of drawing up and defense of arguments and also by problem solving in their professional study field.
- CB4: Sharing information, ideas, problems and solutions with general public and with those specialized in their professional study field.
- CB5: Developing those skill necessaries to begin high level studies in a self-taught learning and in an autonomous way.

Transverse Competencies:

- CT03: Capacity for seeking, choice and management, in a responsible way, of the right information and knowledge.
- CT04: Development of critical thinking and reasoning.
- CT05: To communicate and express results in an efficient and clear way.
- CT07: Analysis and problem solving in an autonomous way, adapting to unforessen situations and making decisions.

Specific Competences:

- CE03: Use of concepts and methods that belong to Physics and Electronics and are necessary for problem solving coming from the adquisition of structured data.

2.2. Learning goals

Those studen who have passed successfully this subject have to show the following learning results:

- Capacity to understand and apply correctly the fundamentals of Electricity and Magnetism and their application in different areas of the applied electricity and electronics.
- Capacity to analyse passive RLC circuits.
- Knowledge of the basic components of an electronic circuit.
- Capacity to analyse and solve different kind of circuits.

2.3. Importance of learning goals

Protocols and algorithms ruling the operation of Computer Systems are embeded inside physical electronics systems in charge of management of information and their transmission. Nowadays Data Engineers have to be able to understand the physical electronic system underlying the codification activities they develope. This physical electronic system is a medium which operation is explained by the Electromagnetism Laws based on the Electromagnetic Interaction; therefore, Data Engineers have to know, understand and master the Physics applied, underlying the work they develope in a transverse way to the circuits operation, logic gates and other elements part of the hardware of their job.

The full knowledge acquired in this subject will allow Data Engineers to know the basic principles of communication through physical channels, comprehend the different motives of hardware continuous changing and also to lead them to propose new desings of circuits based on the knowledge of new materials that can be part of the elements of this hardware.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

Students must show to have fulfilled the foreseen learning outcomes by means of the following evaluation activities:

Progressive Evaluation System

Those students willing to participate in this evaluation system must attend, at least, at an 80% of all the in person activities developed in this subject.

This progressive evaluation system consist of the following group of activities:

- Individual activities in class.
- Laboratory activities.
- Problems, questions and proposed work.
- Midterm exams.

Individual activities developed in class will be marked by the tutor or lecturer of this subject based on the observation of personal interest, aptitude, involvement and progress showed by the student throughout the course. Its purpose is to raise the final mark of the subject and it could be a positive or negative value according to the aptitude of the student. Those students that stand out negatively due to bad behaviour preventing the class from taking place, laboratory activities and other proposed activities, will get a mark of 0 in this item.

The laboratory activities will consist of experiments related to the subjects learned in class of theories in order to verify

experimentally those learned concepts. These activities are going to be done through the course development in extraordinary dates fixed by the tutor or lecturer of the subjec and can not longer be done in another different date. Each of the proposed experiments are going to last a maximum of 2 hours.

The Problems, questions and proposed work activities are going to consist of activities developed by students as leisure activities, such as research essays, analysis and problem solving and laboratory essays redaction.

The following table summarize the marks assigned to each activity mentioned above:

Evaluation activity	Mark
Individual activity in class	10%
Laboratory activities	10%
Problems, questions and proposed work	10%
Midterm exams	70%

Previously to the first final exam all students are going to get a notification from their Tutor or Lecturer telling them if they have passed or fail this subject from the results obtained in the Progressive Evaluation System, based on the sum of the marks got in the different assessment activities developed throughout the course and summing each one of them with at least a 5.0 mark. Those student who failed this subject by this evaluation method will have two different resit dates to pass it (Global Evaluation Examinations), whereas, those who have passed this subject by the Progressive Evaluation System, but wish to get a higher mark, can take the first Global Evaluation Exam in order to improve their mark but not to decrease of failed it.

Global Evaluation Examinations

Students must choose this evaluation method when, by their own personal situation, their cannot get used to the work pace required by the Progressive Evaluation System or they have failed or wish to get a higher mark after having participated or not in the Progressive Evaluation System.

In the same way as the Progressive Evaluation System focus on the learning outcomes check, the Global Evaluation Examinations focus on them contribuiting to the acquisition of the several competencies proposed by this subject.

The Global Evaluation Examination consist of the following group of activities:

- **Lab session:** This activities are going to be developed throught the course within the Progressive Evaluation System calendar giving a 10% grade of the final mark of this subject.
- **Practice session:** The Tutor or Lecturer will propose practical case problems and theoretical questions to solve individually or in groups in order to hand in them at the date define for this activity. It will give a grade of 10% of the final mark.
- **Written exams:** Considering the scientific level of this subject, learned through problem solving and theory comprehension, the exams will consist of a combination of medium level complexity problems, similar to those developed in class, and theoretical questions, with a reasonable answer time of 3.0 hours. The results of theses exams are going to give a grade of 80% of the final mark of this subject.

The following table summarize the marks assigned to each activity mentioned above:

Evaluation activity	Mark
Lab session	10%
Practice session	10%
Written exam	80%

Students are going to pass this subject based on the sum of the marks obtained in the different activities developed, summing each of them with at least a 5.0 mark.

Those students who have failed the Progressive Evaluation System but have passed some of the activities developed in, leaving out the midterm exams, these passed activities are going to be promoted to the Global Evaluation exams leading to cases in which a student must take only the written exam.

All the activities considered in the Global Evaluation Examination, leaving out the written exams, could be promoted to the second resit date within different academic course previous communication to the Tutor or lecturer of this subject.

The evaluation criteria to give the final mark for the Global Evaluation Examinations are:

- Lab session.
- Pratice session.
- Written exam.

In those unforeseen circumstances in which the Continuous Assessment and its proposed activities can no longer be developed, such as the midterm exams and the laboratory practices, due to well justified motives by the University of Zaragoza or the center, these activities are going to be replaced by:

- Two midterm exams for the Progressive Evaluation System, and
- Research essays related to practical applications of this subject for the Laboratory practices.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

This subject has 6 ECTS credits. This makes a total of 150 hours of effective work, being 40% of these hours (60 hours) classroom sessions.

Class work includes theory and practice sessions and laboratory experimental sessions.

Autonomus work includes personal study, problem resolution and development of practical works.

Semester consists in 15 weeks. Each week the student must work 10 hours in this subject.

Teaching will be organized according to the following learning tasks:

- Lectures.
- Practice sessions.
- Laboratory sessions.
- Seminars.
- Tutorials.
- Exams.

Regarding to the slides, proposed exercise photocopies, laboratory session guides and other materials used in class, all of them are going to be available on the Moodle platforma of this subject.

Theory and practice sessions will be developed within the classrooms indicated by the management team of the center. Laboratory sessions will be developed in the Physics laboratory of the EUPLA located on the third floor of the building situated in the "Calle Mayor".

Further information regarding the course will be provided on the first day of class.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

This 6 ECTS (150 hours) course is organized as follows:

- **Lectures:** (2 ECTS: 20 h). Exposition and contents of the subject. Development of theories of Electrostatics, Electrodynamics, Magnetism and Electromagnetic Waves, analysing their mathematical equation and implications. Students involvement will be boost throughout this acitivity by working out problems, questions interpretation and analysis.
- **Practice sessions:** (2 ECTS: 20 h) The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Laboratory sessions:** (1.75 ECTS: 17.5 h). This work is tutored by a teacher, in groups of no more than 20 students.
- **Seminars:** (0.25 ECTS: 2.5 h) It is tutored by teachers from other subjects of this degree with the purpose to show the students the different applications of Fundamentals of Physics in the Degree of Engineering in Data an Industrial Processes.
- **Autonomous work and study:** (90 hours) Study and understanding of the theory taught in the lectures. Understanding and assimilation of the problems and practical cases solved in the practice sessions. Preparation of seminars, solutions to proposed problems, etc. Preparation of laboratory workshops, preparation of summaries and reports. Preparation of the written tests for continuous assessment and final exams.
- **Tutorials:** Those carried out giving individual, personalized attention with a teacher from the department. These tutorials may be in person or online.
- **Exams:** Written assessment tests will be developed within the temporalization of theory and practice sessions.

4.3. Syllabus

According to the Essay of Verification of this degree, this subject is structured around the following contents:

- Electric and Magnetic fields.
- Electromagnetism.
- Maxwell's equations.
- Electromagnetic waves.
- Circuit theory.

4.4. Course planning and calendar

Estimated timetable of lectures:

Week	Topic	Theme
1	I	Magnitudes and vectors
1	II	Discrete charge distribution: electric force and electric field
2	III	Continuous charge distribution: electric field and Gauss' law
3	IV	Electric potential and electric potential energy
4	V	Electrostatic energy and electrical capacity
5	VI	Electrodynamics: direct current (dc) and electrical circuits
6	VI	Electrodynamics: general applications
7	VII	The magnetic field
8	IVIII	Magnetic field sources
9	IX	Magnetic induction. Applications to circuits.
10	X	Alternating current (AC). Applications to circuits
11	X	Magnetism: general aplications
12	XI	Wave motion: waves and wave phenomena
13	XII	Maxwell's equations and Electromagnetic Waves
14	XIII	Electromagnetic waves: signals and information transmission
15	XIII	Electromagnetism: general applications

Important dates, such as work presentations, laboratory practices, written exams, among other foreseen acitivities will be communicated to the students in the classroom or through the Moodle platform with enough time in advance. Seminars will be on Friday. Such dates will be decided by the Tutor or Lecturer and students will be informed with at least 15 days in advance in case of seminars and midterm exams and 7 days in advance in case of other assignment tasks.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the EUPLA website (http://eupla.unizar.es/).

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=29502