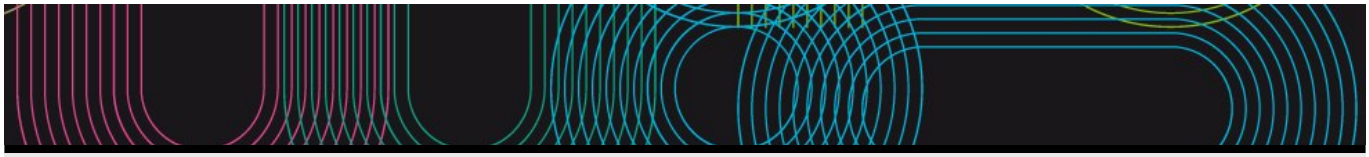

IDENTIFYING DATA

Electronic technology

Subject	Electronic technology			
Code	P52G381V01301			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Troncoso Pastoriza, Francisco Manuel			
Lecturers	Falcón Oubiña, Pablo Troncoso Pastoriza, Francisco Manuel			
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General description	The objective of this course is to provide the students with the theoretical and practical fundamental knowledge in electronics' five main areas: analog electronics, digital electronics, industrial sensors, power electronics and communications electronics. In case of any discrepancy between this translation of the guide and the Spanish version, the valid one is the Spanish version.			

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.
C11	Knowledge of the fundamentals of electronics.
D2	Problems resolution.
D9	Apply knowledge.
D10	Self learning and work.
D17	Team working.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
To know of the operation of electronic devices.	B3	C11	D2 D9 D10 D17
Know conditioning and data acquisition electronic systems and devices.		C11	D10
To identify different types of industrial sensors.		C11	D10
To know the basics of a digital electronic system.		C11	D2 D9 D10 D17
To know basic electronic circuits for data communications.	B3	C11	D9 D10
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING LO 1.3 Be aware of the multidisciplinary context of engineering. (level of development of this sub-learning outcome: Basic (1))		C11	

ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS LO 2.2 Ability to identify, formulate and solve engineering problems within an specialty; choose and apply properly analytical methodologies; recognize the importance of social, health and safety, environmental, economic and industrial restrictions. (Medium (2))	D2 D9
ENAEE LEARNING OUTCOME: COMMUNICATION AND TEAMWORK LO 7.2 Ability to operate properly within national and international contexts, both individually and as a team, and cooperate with engineers and/or people from other disciplines. (Medium (2))	D10 D17
ENAEE LEARNING OUTCOME: CONTINUOUS EDUCATION LO 8.1 Ability to realize the need for continuous training and undertake this activity throughout their professional life on their own. (Medium (2))	D10
ENAEE LEARNING OUTCOME: CONTINUOUS EDUCATION LO 8.2 Ability to stay up-to-date on science and technology. (Basic (1))	D10

Contents	
Topic	
Digital Electronics	- Basic concepts - Logical values: positive and negative logic - Logical families: TTL, ECL, CMOS - Binary functions and basic logic blocks - Truth table - Karnaugh maps - Basic integrated circuits - Design of basic combinational digital systems
Operational Amplifiers	- Basic concepts - Differential amplifier and operational amplifier - The op. amp.: terminals, feedback, virtual shortcut - Op-Amp circuits with closed-loop and negative feedback: inverting and non-inverting amplifiers, summing amplifier, differential amplifier, integrator, differentiator,... - Design of analog systems based on operational amplifiers
The diode	- Basic concepts - Semiconductors - The diode - The zener diode - Other diodes: LED, photodiode, etc. - Applications
The Bipolar Junction Transistor (BJT)	- Structure - BJT operation - Polarization, load line analysis and operating point (Q) - Applications
Field-Effect Transistor (JFET)	- Structure - Families of FET transistors - Polarization - Applications
Small-Signal Amplifiers	- Amplifier gain: voltage amplifier, current amplifier - Input impedance - Output impedance - Small-signal model for BJT - Small-signal model for JFET
Applications	- Data acquiring systems - Sensors and actuators - Analog to digital converter - Design of digital and analogical electronic systems - Industrial communications
Practice 1: Circuit simulation	The goal of this practice is to introduce the Autodesk Tinkercad electronic circuit simulation software to carry out assemblies with digital electronic elements focused on solving basic engineering problems. This software will be used to complement the laboratory assemblies during practice sessions 3 to 6, allowing a first contact in a more accessible and simple way before transferring the simulated scheme to the real prototype.
Practice 2: Digital Electronics	This practice introduces the student to digital combinational circuits by assembling basic circuits within a protoboard.
Practice 3: Basic electronic circuits with operational amplifiers	The goal of this practice is introducing the closed-loop operation of these types of amplifiers, by assembling different circuits within a protoboard.

Practice 4: Basic electronic circuits with diodes	This practice shows the student different circuits for diodes (rectifiers, trimmers, ...), by assembling them in a protoboard and testing them with different input signals.
Practice 5: Basic electronic circuits with transistors	This practice shows basic circuits with transistors (mainly BJT) in order to show the polarization concepts shown in theory.
Practice 6: Multistage amplifier design	This practice tries to merge all the concepts learned during the course for analog devices by designing a simple multistage amplifiers conformed by a small-signal amplifiers followed by one (or more) stages of high power amplifiers (wit op-amps).
Practice 7: Laboratory evaluation test	This is a test where the ability acquired by the student for the simulation and assembly of electronic circuits and the verification of its operation with the instruments used in the practices will be evaluated. The test will consist of two parts: the first one will be dedicated to the simulation in the Tinkercad program, and the second will consist of the assembly and validation of a proposed electronic circuit, which will include various components treated during the rest of the laboratory sessions.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	12	12	24
Seminars	22	0	22
Problem and/or exercise solving	7	13	20
Problem and/or exercise solving	1.5	2	3.5
Problem and/or exercise solving	1.5	2	3.5
Laboratory practice	2	2	4
Laboratory practice	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	They will consist in an oral explanation by the lecturer of the most important parts of the course, all related with the materials that the student had to work previously. This is intended to favor the active participation of the students, that will have occasion to rise doubts and questions during the sessions. Active participation is desired during all the sessions.
Laboratory practical	During these sessions, in the classroom, interleaved with the lectures, the lecturer will proceed to solve examples and/or exercises that properly illustrate the problems to solve. As long as the number of participants in the classroom allows, active participation will be promoted.
Seminars	Previous preparation of the theoretical sessions: Prior to the start of the theoretical sessions, the students will have available a series of materials that have to prepare, as the sessions will relay on them. Previous preparation of the laboratory sessions: It is mandatory that the students make all the assigned previous tasks prior to access the laboratory. These task are intended to greatly improve the laboratory knowledge acquisition. The achieved report will be taken into account when the laboratory session is to be evaluated. This section includes the intensive course designed for preparing the extraordinary exam.

Personalized assistance

Methodologies	Description
Seminars	In the scope of tutorial action, academic tutoring actions and personalized tutoring are distinguished. Within the first option, students will have tutoring hours where they can ask questions related to the subject contents, organization and/or planning. In personalized tutoring hours, each student, individually, can discuss with the lecturer any problem regarding his/her understanding of the subject. Both tutorial actions aim to compensate the different learning rhythms through attention to diversity. The lecturers of the subject will personally answer the questions and queries of the students, according to the schedule that will be published on the website of the center, such as through telematic means (email, videoconference, MOOVI forums, etc.) under the modality of previous appointment.

Assessment

	Description	Qualification	Training and Learning Results

Problem and/or exercise solving	Final exam to evaluate the global knowledge acquired of the subject, due at the end of the semester.	40	B3	C11	D2 D9 D10
Problem and/or exercise solving	First assessable test of the knowledge acquired up to that moment (approximate date: around the 5th week of the semester).	15	B3	C11	D2 D9 D10
Problem and/or exercise solving	Second assessable test, corresponding to themes 3, 4 and 5 (approximate date: 9th week of the semester).	15	B3	C11	D2 D9 D10
Laboratory practice	Resolution of practical problems, attitude, cleaning and care of the material (approximate date: practical sessions 1 to 6)	15	B3	C11	D2 D9 D10 D17
Laboratory practice	Laboratory exam where the ability to understand, ensemble and simulate basic electronic circuits are tested (approximate date: last practice session).	15	B3	C11	D2 D9 D10 D17

Other comments on the Evaluation

The student evaluation and qualification criteria proposed for this subject are set out. Given the peculiarities of the Centro Universitario de la Defensa, where this subject will be taught, and taking into account that the students are in a boarding school, only evaluation criteria for assistants are proposed.

Ordinary call:

Continuous evaluation

In the ordinary call, a process of continuous evaluation is carried out in which the weight of the different parts in which the subject is structured over the final mark is as follows:

- Knowledge of theory (T): 70%
- Practical knowledge (L): 30%

Knowledge of theory:
The theory knowledge part is evaluated by combining two scoring tests and a final exam as follows:

- Partial exam 1 (*P1*):
  - A test of approximately 1 hour and a half in length and preferably located at the end of themes 1 and 2 of the subject.
  - Weight: 15% of the continuous assessment score (NEC).
  - It is qualified with 10 points.
  - Made individually.
  - It can take the form of a multiple choice questionnaire, short answer questionnaire, problem solving or some combination of the above.
  - **There is no minimum qualification.**

- Partial Exam 2 (*P2*):
  - A test of approximately 1 hour and a half, preferably located at the end of themes 3 and 4 of the course.
  - Weight: 15% of the continuous assessment score (NEC).
  - It is qualified with 10 points.
  - Made individually.
  - It can take the form of a multiple choice questionnaire, short answer questionnaire, problem solving or some combination of the above.
  - **There is no minimum qualification.**

- Final exam (*EF*):
  - Exam to be taken on the evaluation dates.

- Weight: 40% of the continuous assessment score (NEC).
- It is qualified with 10 points.
- Made individually.
- They can be in the form of a multiple choice questionnaire, short answer questionnaire, problem solving or some combination of the above.
- **A minimum qualification of 4.0 is required.**

Practical knowledge:

The practical part of the course is assessed by means of a practical laboratory test, as follows:

- Practical laboratory exam (*PL*):
  - During each practical session, the student will be asked various questions or simulation and assembly exercises that they must carry out during the corresponding session. The attitude of the student during the class will also be evaluated, as well as the cleanliness of the workplace at the end of the practice and the care of the material provided in the laboratory.
  - The realization of the test is individual.
  - Weight: 15% of the continuous evaluation score (NEC).
  - It is qualified with 10 points for each laboratory session.
  - **There is no minimum qualification exclusive to this item.**

- Practical laboratory exam (*EL*):
  - This is a test to evaluate the ability acquired by the student to simulate and assemble electronic circuits and to check their operation with the instruments used in the practices.
  - The realization of the test is individual.
  - Weight: 15% of the continuous evaluation score (NEC).
  - It is qualified with 10 points.
  - **There is no minimum qualification exclusive to this item.**

Final mark and minimum requirements to pass the course through continuous assessment:

To ensure that the student has acquired the minimum skills in each of the aspects of the subject, students will be required to achieve a minimum score of 4.0 out of 10 in the final exam of theory (EF), and a minimum score of 4.0 out of 10 in the practical part (L).

In this way, the final mark in continuous assessment (NEC) is calculated using the following formulas, a minimum mark of 5.0 in the NEC being necessary to pass the course:

NEC = 0.15*P1 + 0.15*P2 + 0.4*EF + 0.15*PL + 0.15*EL
In the event that the minimum mark required in any of the parts is not reached, the final mark for continuous assessment will be calculated as:

NEC = min(4.0, NEC)
The student who does not pass the course in continuous evaluation must take the ordinary exam.
Ordinary exam

- Knowledge of theory (T): 70%
- Practical knowledge (L): 30%

Theory:

Consists of:

- A single exam, of approximately 3 hours, to be performed within the course calendar.
- It is qualified with 10 points (T).
- Individual.
- It can include tests, short questions and/or problems or a combination of them.

Laboratory:

Consists of:

- A single practical exam, of approximately 45 min, at the laboratory, related to the practical contents of the subject.
- It is qualified with 10 points (L).
- Individual.

Final mark and minimum requirements to pass the subject:

The final mark (NEO) will be computed following the next equation:

NEO = 0.7 * T + 0.3 * L

A minimum of 4.0 out of 10 points are required for the T exam, and a minimum of 4.0 out of 10 points are required for the L exam. Once obtained these minimums, a punctuation equal or higher than 5.0 points over 10 in the total computation of NEO is mandatory to pass the subject.

Extraordinary exam:

The students that did not pass the subject on first convocatory must attend the second convocatory (or extraordinary exam), that will have the same structure, exam duration, percentages and minimum points required than in the ordinary exam.

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

Malvino, Albert; Bates, David J., **Principios de Electrónica**, 7ª,

E. Mandado, **Sistemas Electrónicos Digitales**, 10ª,

Complementary Bibliography

R. Pallás Areny, **Sensores y acondicionadores de señal**, 4ª,

J. Millman, **Microelectrónica. Circuitos y sistemas analógicos y digitales**, 4ª,

N. R. Malik, **Circuitos Electrónicos. Análisis, simulación y diseño**, 1ª,

T. L. Floyd, **Fundamentos de Sistemas Digitales**, 9ª,

Recommendations