



Universitat de Lleida

# DEGREE CURRICULUM

# **POWER ELECTRONICS**

Coordination: GARRIGA CASTILLO, JUAN ANTONIO

Academic year 2023-24

## Subject's general information

<b>Subject name</b>	POWER ELECTRONICS			
<b>Code</b>	102122			
<b>Semester</b>	2nd Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Bachelor's Degree in Automation and Industrial Electronic Engineering	3	COMPULSORY	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRALAB	PRAULA	TEORIA
	<b>Number of credits</b>	1	2	3
	<b>Number of groups</b>	2	1	1
<b>Coordination</b>	GARRIGA CASTILLO, JUAN ANTONIO			
<b>Department</b>	INDUSTRIAL AND BUILDING ENGINEERING			
<b>Teaching load distribution between lectures and independent student work</b>	60h of class 90h of autonomous work 1 ECTS = 10h of class + 15 h of autonomous work			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	Català 20.0 Castellà 80.0			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
GARRIGA CASTILLO, JUAN ANTONIO	juanantonio.garriga@udl.cat	7	Wednesday from 17:00 to 19:00 h / Office 2.18 entrance by 2.19.  Confirm attendance via email

## Subject's extra information

Power Electronics requires other skills acquired in areas such as subjects of Electrical Technology, Circuit Theory and Fundamentals of Electronic Engineering. Computer skills are interesting and practical use of advanced applications in personal computers since it offers good support for mathematical analysis and systems simulation

Power Electronics is a course of six mandatory ECTS credits, taught in the second quarter of the third course of Engineering Degree in Industrial Electronics and Automation. This course introduces students to the analysis and design of power electronic systems for industrial applications with emphasis on semiconductors power most used, switched power converters (ac / dc, dc / dc, dc / ac, ac / c) in its various topologies and feeding different loads, as well as provide a comprehensive overview of the many fields of application of this discipline.

## Learning objectives

- Acquire a vision of power electronics.
- Knowing several types of power semiconductor devices and switching characteristics.
- Learning classes of power converters.
- Use basic circuit analysis techniques to analyze the performance of circuits in power electronics.
- Graphical and analytical understanding of the functioning of electronic power circuits.

## Competences

### Cross - disciplinary competences

- **EPS1.** Capacity to solve problems and prepare and defence arguments inside the area of studies.
- **EPS6.** Capacity of analysis and synthesis

### Specific competences

- **GEEIA20.** Knowledge of the basics and applications of the analogue electronics.
- **GEEIA21.** Knowledge of the basics and applications of the digital electronics and microprocessors.
- **GEEIA22.** Applied knowledge of power electronics.
- **GEEIA23.** Applied knowledge of electronic instrumentation
- **GEEIA24.** Capacity to design analogue, digital and power electronic systems.

## Subject contents

1. Introduction to Power Electronics
2. Power Semiconductors
  - 2.1. Diode.
  - 2.2. Thyristor.

- 2.3. GTO
- 2.4. TRIAC
- 2.5. Bipolar Transistor
- 2.6. MOSFET
- 2.7. IGBT

### 3. Converters

- 3.1. Conversion of alternating current-direct current (AC / DC)
- 3.2. Conversion of alternating current-alternating current (AC / AC)
- 3.3. Conversion of direct current-direct current (DC / DC)
- 3.4. Conversion of direct current-alternating current (DC / AC)

### 4. Applications of Power Electronics

## Methodology

The activities are divided into three parts: lectures, problem solving and practical.

**Lectures:** Lectures present the contents of the subject orally by a teacher without the active participation of the students. At the end of the session, or when deemed appropriate, a question time will be opened.

**Problem solving:** In the problem solving activity, teachers present a complex issue that students must solve, either working individually or in teams.

**Practices:** They allow to apply and configure, in a simulated way, the theory of a field of knowledge in a specific context. The student must have theoretically analyzed the circuits to be able to obtain conclusions with the simulation and to be able to make a paper report to present for evaluation.

The non-contact activities are divided into two parts: strengthen their knowledge autonomously based on the teaching material provided or recommended by the teacher, and reporting on the development of practices.

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Laboratory gown from UdL (unisex)

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos  
Centre the Cultures i Cooperació Transfronterera

<http://www.publicacions.udl.cat/>

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

### GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.

- Long hair needs to be tied.
- Keep the laboratory gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: <http://www.sprl.udl.cat/alumnes/index.html>

## Development plan

Week	Methodology	Temary	Contact hours	Independent work hours
1	Master class problems	Tema1	4 h	6 h
2-3	Master class Simulation Practices	Tema 2	8 h	12 h
4	Master class problems	Tema 3	4 h	6 h
5-6	Master class Simulation Practices	Tema 3	8 h	12 h
7-8	Master class problems	Tema 3	8 h	12 h
9	Written test Delivery practices	Tema 1 a Tema 3 Practices	2 h	
10-11	Master class Simulation Practices	Tema 3	8 h	12 h
12	Master class problems	Tema 3	4 h	6 h
13-14	Master class Simulation Practices	Tema 3	8 h	12 h
15	Master class problems	Tema 4	4 h	6 h
16	Written test Delivery practices	Tema 3 a Tema 4 Practices	2 h	

During the first weeks of the course theory classes and problems of the first issue were developed, and then the practice sessions developed for the issue began.

This development plan will be conducted throughout the course, so, practices will be held once acquired knowledge to carry them out.

The corresponding practical reports will be delivered as the same day deadline set for the completion of the partial examination, must contain the theoretical results and simulated practices made to date.

## Evaluation

To pass the subject it is necessary to pass each of the two evaluation blocks: theory and practicals.

The maximum qualification of the evaluation blocks will only be obtained when the activities of each block are delivered within the established deadlines and days.

Attendance at laboratory practices is compulsory.

Theory (Exams) 70%, first partial 35%, second partial 35%. The minimum mark in each partial exam to be able to average with the other, will be 4 out of 10. Minimum theory mark to pass the subject 5.

Practices 30% (Problems-Non-contact work and Laboratory):

Laboratory Practices (Assistance + Reports) 20%, the reports must contain the corresponding analysis of the practice, the simulation and the empirical data obtained. Practices from previous years will not be validated.

Problems-Non-classroom work (Collection of solved problems, at least the correct resolution of the exams within the maximum agreed period) 10%

The recovery exams will only be used to pass students who did not present or failed in the partial exams (maximum mark to be reached in the recovery 6 points) and for those who, having passed the partial exams, want to raise their grade (previous request is necessary).

Any exam question to evaluate part of the agenda may be replaced by some work and/or presentation in class.

In the case of substituting exam questions on a specific topic for assignments and/or class presentations, the minimum grade to be obtained from the exam for the assignments to be counted will be 50% of the rest of the exam questions.

The maximum qualification in the recovery of the Laboratory practices will be approved (1 point out of 2).

This evaluation will also apply to students who, after requesting the alternative evaluation system, have been granted it, so they must attend the laboratory to do the practicals, being exempt from attending problem and theory classes.

## INSTRUCTIONS FOR THE CORRECT DEVELOPMENT REVIEW

Present the DNI / Passport in the test.

Always follow the instructions of the teacher in the allocation of seats to fill.

Leave necessarily always visible on the table ID / Passport, writing utensils and possible materials authorized for testing.

Leave folders, bags and / or backpacks where the professor noted.

Mobile phones or any telecommunications device must be disconnected and stored in bags or backpacks. The use of these devices and some other unauthorized material is strictly forbidden. If it detects that a student has activated, it will be expelled from the examination with the consequences arising.

You can not answer pencil, nor red or green ink.

While performing tests all students must have the pinna (ear) discovered for verification that they are not using

hearing aids not allowed. During the exam students must always have both hands visible.

Correction and absolute silence during the examination.

The teacher may expel any student test violates these standards, with the consequences arising.

## GENERAL CRITERIA FOR THE CORRECTION OF TESTS

If you consider a section divided in approach ("We ..." "You ask ..."), development ("The application of Theorem with this hypothesis allows ...") and resolution ("In the expression of the theorem is replaced ... and simplifying get ... ") until the result, to gain score paragraph must be presented in an orderly and intelligible development.

One result is rejected if the source, that is to present a coherent development with the statement (no need to make an explicit approach, or copy or recreate the statement) is not indicated.

For maximum score is required, where applicable:

- Getting the correct numerical result with SI units (International System).
- Presenting graphic indicating the scales with correct units.
- Present schemes, block diagrams, etc. unambiguously.
- Pulchritude, conciseness, accuracy and clarity of presentation will be highly valued.

It is heavily penalized so could nullify the score in a section:

- The dimensional and conceptual errors in reasoning.
- The results without units or SI units are not.
- The numerical errors that lead to reasonable results only slightly penalized.
- Other numerical errors can become considered misconceptions.
- In chained questions are not heavily penalized errors arising from the above results, provided that taking these as data does not represent a conceptual error and the results derived are reasonable.

## Bibliography

**Título:** ELECTRÓNICA DE POTENCIA: CIRCUITOS, DISPOSITIVOS Y APLICACIONES.

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**Título:** FUNDAMENTALS OF POWER ELECTRONICS

**Autor/es:** Erickson, Robert W. ; Maksimovic, Dragan ;

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**Título:** Power Electronics: Converters, Applications and Design

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**Título:** ELECTRÓNICA DE POTENCIA

**Autor/es:** Hart, Daniel ;

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**Autor/es:** Eduard Ballester, Robert Piqué ;

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**Autor/es:** Martínez García, Salvador ; Gualda Gil, Juan Andrés;

**Editorial:** THOMSON PARANINFO,S.A.

**Título:** PROBLEMAS DE ELECTRÓNICA DE POTENCIA

**Autor/es:** Andres Barrado, Antonio Lázaro ;

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**Autor/es:** William H. Hayt, Jack E. Kemmerly, Jamie D. Phillips, Steven M. Durbin

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