VNIVERSITAT DE VALÈNCIA

Course Guide
34939 Power electronics

COURSE DATA

Data Subject	
Code	34939
Name	Power electronics
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1404 - Degree in Industrial Electronic Engineering	School of Engineering	3	Second term

Subject-matter

Degree	Subject-matter	Character
1404 - Degree in Industrial Electronic Engineering	17 - Power electronics	Obligatory

Coordination

Name	Department
MASET SANCHO, ENRIQUE	242 - Electronic Engineering

SUMMARY

This course is compulsory and is provided in the second semester of the third year of the degree in Industrial Electronics Engineering. The total workload is 6 ECTS credits distributed in 2 theoretical credits, 1-credit problems and 3 credits of laboratory.

This course together with the so-called subject electronics Industrial (4th year) forms the power electronics field. In general, the subject of power electronics is the study of devices, circuits, systems and procedures for the processing, control and conversion of electrical energy.

With this concept dealt with systems AC/DC and DC/DC, as the alternatives in the power conversion depending on the nature and electrical characteristics of the primary source of energy and the burden to feed. Throughout the course presents the principles of operation of different topologies which constitute them.

Is a subject that is present in most electronic equipment, so represents a technological support independent of the industrial sector to which we refer.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

The background needed for the subject is acquired in previous courses of the degree. As a subject that covers a particular discipline of electronics, electronic subsystems are analysed from the knowledge of basic analogue electronic devices, the fundamentals of electrical network theory and basic skills of electronic control.

1404 - Degree in Industrial Electronic Engineering

- CG3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- CG4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering (with specific industrial electronics technology).
- CG6 - Ability to deal with specifications, regulations and mandatory standards.
- CE4 - Applied knowledge of power electronics.

This subject allows to obtain the following results of learning:

- Know the basic structure of the power devices, his way of operation and his static and dynamic characteristics (CG3, CG4, CG6 and CE4).
- Understand and analyse the operation of the AC/DC and DC/DC power converters in his different topologies and feeding different loads (CG3, CG6 andCE4).

In addition to the specific objectives mentioned above, the course will encourage the development of various social skills and techniques, which include:

- Be able to select different devices used in a power circuit. In particular power semiconductors devices.
- Understand the operation, including analysis and design of different power conversion topologies used in power electronics.
- Learning software using for simulation and design of power converters.

DESCRIPTION OF CONTENTS

1. Fundamentals of power electronics

Introduction. Concept of power electronics. Technological evolution and devices used. Energy conversion. Classification. Block diagram of a power converter. Sources and loads of power.

2. Power Electronic Devices

Power switches: diodes, field effect transistors, insulated gate bipolar transistors and thyristors. Static characteristics. Dynamic characteristics.
Resistors and capacitors: characteristics, types and equivalent circuits.

3. AC-DC converters

Rectifiers. Structures P, PD and S. Characteristic parameters. Controlled rectifiers and semi-controlled. Voltage drops. RL and RLE loads.

4. DC-DC Converters

Introduction to regulating the DC-DC converters techniques. Ancillary circuits.
Introduction to DC-DC regulators. Dissipative and non-dissipative. Classification.
Non-isolated switched-mode power converters: Buck, Boost and Buck-Boost topology.

5. Power Electronics Laboratory

Experimental development of different prototypes of power converters:

Operation of rectifiers non-controlled: RL loads and power diagrams.
Operation of rectifiers: Full-controlled and Semi-controlled.
Operation of a Buck DC-DC switched-mode converter: Continuous and discontinuous mode.
PSIM Simulation of a DC-DC switched-mode converter.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	30,00	100
Theory classes	20,00	100
Classroom practices	10,00	100
Development of individual work	10,00	0
Study and independent work	30,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	15,00	0
Resolution of case studies	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The methodology to employ in the education of this subject develops mainly under the following concepts:

Theory sessions: it understands like Classes of theory the time that passes, usually in a classroom, between the professor and the group of students developing theoretical concepts. During these classes will expose the theoretical foundations that it states the subject, employing different methods that can change in function of the didactic unit (CG3, CG6 and CE4).

Exercises sessions: it understands like exercises classes the time that passes, usually in a classroom, between the professor and the group of students resolving practical exercises. During these classes the students will resolve questions and practical problems with the assistance of the professors. The exchange of ideas between students and interventions is encouraged by proposing common corrections (CG4, CG6 and CE4).

Laboratory sessions: it understands like Classes of laboratory the time that passes in a classroom of laboratory. During these classes the students have of tools of software and electronic material to verify of experimental way the theoretical concepts, as well as the possibility to confirm also the solutions of the exercises (CG3, CG4, CG6 and CE4).

Student's homework: Preparation of the classes, resolution of problems, preparation of works, previous preparation of the sessions of laboratory and preparation of reports

- **Preparation of the classes**: Refers to the individual study to be done by the student before and / or after attending class, as instructed by the teacher. That way he prepares to understand what is going to be explained in it, and to be able to ask questions throughout that class (CG3, CE4).

- **Troubleshooting**: Time used by the student to perform some of the problems proposed by the professor. Some of these problems will be discussed in face-to-face problems sessions (CG4, CG6 and CE4)

- **Preparation of works**: Time that employs the student to make individual works or in-group proposed by the professor (CG3, CG4, CG6 and CE4).

- **Preparation of laboratory sessions and lab-reports**: It corresponds to the time that the students dedicate to understand the practice that they realized in the laboratory, delivering when appropriate, a previous questionnaire. It also includes the time devoted to the report of laboratory practices, once completed (CG3, CG4, CG6 and CE4).

Tutorials

The tutorial have a double aim, by a part, have to serve fundamentally so that the students orient adequately his method of study and, on the other hand, the professor have a feedback method to check the efficiency of the educational method. Also the tutorial will serve for clarify of personalised way doubts of technical character related with any part of the subject. The tutorial will be so much face-to-face as no face-to-face through the platform web “classroom-virtual” (CG4 and CE4).

EVALUATION

The examination has two different ways:

• Procedure A: The continuous evaluation of the results of learning along the entire course.

• Procedure B: The final evaluation, in second announcement, by means of an exam.

Procedure A:

CONTINUOUS EVALUATION OF THEORY-PROBLEMS (CG3, CG4, CG6 and CE4). The part of theory-problems evaluates of continuous way whit a weight of 50% for the total course score. They consist in two types of verifications: EXAM and HOMEWORKS.

T-P EXAM (35% of the final course score): Individual exam. There will be one midterm exam (chapters 1, 2 and 3) and one final exam. Student that pass the midterm exam only need to be evaluated of chapter 4 at the final exam. This activity is recoverable in the second announcement.

HOMEWORKS (15% of the final course score): it contains works/face-to-face problems and no face-to face, in-group like individual. This homework’s will take for the final qualifications whenever of individual way obtains a score higher or equal to 5 over 10. The works delivered out of the term established will not be considered for the final score. This activity is not recoverable in the second announcement.

EVALUATION OF THE LABORATORY (CG3, CG4, CG6 and CE4).

The evaluation of the laboratory sessions will make of continuous way, whit a weight of 50% for the total course score. The continuous evaluation has two parts:

- A 25 % corresponds to the laboratory reports.
- A 25 % corresponds to an individual laboratory final exam.

The corresponding qualification to the laboratory reports will be the arithmetical average of the qualifications obtained in each report, considering only the reports that obtain a qualification of at least 4 points over 10. This activity is not recoverable in the second announcement.

The assistance to the practices of laboratory is compulsory and necessary to be able to pass the subject. Being the assistance to the laboratory a no recoverable activity. It considers that the student has fulfilled said activity if it has assisted a minimum of 80% of the hours of this activity and has justified adequately the impossibility to assist to the remaining sessions by the concurrence of a cause of main force.

The student evaluated in a continuous procedure that don’t have pass the subject, will be able to recover, in the final exam of the second announcement, the corresponding qualification of the T-P EXAM (35 % of the final course score) and the LABORATORY FINAL TEST (25 % of the final course score).

To obtain the average among the different qualifications, will be necessary obtain a minimal note of 5 on 10 at the examination of the theory-problems part, at the laboratory tasks and at the individual final laboratory examination

Procedure B: EVALUATION BY FINAL EXAMINATION in second announcement (CG3, CG4, CG6 and CE4).

For those students that have not followed the continuous evaluation, have of a method of evaluation in second announcement based in:

• Final Exam of Theory-Problems (35% of the total course score)

• Final Exam of Laboratory (25% of the total course score)

• Practical implementation at the Laboratory (40% of the total course score)

To be able to pass the subject by means of the final exam, will have to obtain a score of 5 over 10 in each of the three individual verifications.

In any case, the system of evaluation will govern by the established in the Regulation of Evaluation and Qualification of the University of València for Degrees and Masters.

(https://webges.uv.es/uvtaeweb/muestrainformacionedictopublicofrontaction.do?idedictoseleccionado=5639)

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Additional

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- Eduard Ballester, Robert Piqué: Electrónica de potencia : principios fundamentales y estructuras básicas. Marcombo, 2011 ISBN:9788426716699