

**COURSE DATA****Data Subject**

<b>Code</b>	34812
<b>Name</b>	Electronic Products Design
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	6.0
<b>Academic year</b>	2016 - 2017

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
1402 - Degree in Telecommunications Electronic Engineering	School of Engineering	4	First term
1404 - Degree in Industrial Electronic Engineering	School of Engineering	4	First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1402 - Degree in Telecommunications Electronic Engineering	15 - Electronic instrumentation, equipment and products	Obligatory
1402 - Degree in Telecommunications Electronic Engineering	22 - Optional subjects	Optional
1404 - Degree in Industrial Electronic Engineering	21 - Optional subjects	Optional

**Coordination**

<b>Name</b>	<b>Department</b>
ESTEVE GOMEZ, VICENTE	242 - Electronic Engineering
JORDAN MARTINEZ, JOSE FRANCISCO	242 - Electronic Engineering

**SUMMARY**

The purpose of this course is to develop concepts and methods related to the "engineering electronic equipment" with which it is possible to successfully address the design of electronic products. It is important that students be aware that all design must consider concepts like functionality, reliability or security, without losing sight of other equally important as cost, durability, maintainability or preparing the product for manufacturing and marketing according to the regulations, through proper documentation and after due protection and dissemination of technological content. Emphasis will be on design



considerations and testing techniques leading to regulatory compliance relating to Electromagnetic Compatibility (EMC) of the product.

## 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 to follow the course of the course are those acquired in the fields of physics, mathematics and circuits and electronic and photonic components taught in previous courses.

## OUTCOMES

### 1402 - Degree in Telecommunications Electronic Engineering

- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G9 - Ability to work in a multidisciplinary environment and in a multilingual group and to communicate, in writing and orally, knowledge, procedures, results and ideas related to telecommunications and electronics.
- G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.
- TE3 - Ability to specify, implement, document and set-up electronics, instrumentation and control equipment and systems, considering both technical aspects and the relevant regulatory requirements.
- TE8 - Ability to specify and use electronic instrumentation and measurement systems.
- TE9 - Ability to analyze and solve the problems of interference and electromagnetic compatibility.

### 1404 - Degree in Industrial Electronic Engineering

- CO1 - More comprehensive skills than those acquired in compulsory subjects must be acquired in elective subjects.



## LEARNING OUTCOMES

After making the course the student should have acquired a number of skills. After completing the course the student should be able to:

1. Ask designing an electronic product.
2. Prototyping.
3. Specify the tests to be performed on the product design.
4. Knowing the rules and techniques relating to electromagnetic compatibility of an electronic
5. Manage databases and information services technology patent.
6. Write reports, claims and assignment and licensing agreements.

## DESCRIPTION OF CONTENTS

### 1. INDUSTRIAL DESIGN PROCESS.

- 1.1. Introduction.
- 1.2. Design Process.
  - 1.2.1. Specification of requirements.
  - 1.2.2. Physical Design.
    - 1.2.2.1. Methodology. Modularity.
    - 1.2.2.2. Importance of interfaces.
    - 1.2.2.3. Computer aided design. CAD.
  - 1.2.3. Prototyping.
  - 1.2.4. Tests.
- 1.3. Rapid prototyping.
  - 1.3.1. Concept and historical development.
  - 1.3.2. Fundamentals and advantages of rapid prototyping.
  - 1.3.3. The sequence of the rapid prototyping process.

### 2. DESIGN STANDARS

Descripció de continguts (English):

- 2.1. Quality.
  - 2.1.1. Functionality
  - 2.1.2. cost
  - 2.1.3. Maintainability
  - 2.1.4. utility
  - 2.1.5. durability
- 2.2. Reliability.



- 2.2.1. Failure rate
- 2.2.2. Reliability calculation
- 2.2.3. MFBF and MTTF
- 2.3. Security.
- 2.3.1. general criteria
- 2.3.2. electrical Safety
- 2.3.3. Protections
- 2.4. electromagnetic Compatibility
- 2.4.1. EU Directive
- 2.4.2. specific regulations
- 2.5. CE

### **3. DESIGN CRITERIA AND TESTING OF ELECTRONIC PRODUCTS**

- 3.1. Introduction.
- 3.2. Electronic circuit design.
- 3.2.1. Design of instrumentation and control circuits.
- 3.2.2. Power circuit design.
- 3.2.3. Printed Circuit Design.
- 3.3. Design layout.
- 3.4. Interface design.
- 3.5. Design of boxes and enclosures.
- 3.5.1. Grounding and shielding.
- 3.5.2. Protection against dust and moisture.
- 3.6. Cooling design.
- 3.7. Testing of the prototype.
- 3.7.1. Compliance tests.
- 3.7.2. Essays in the worst condition. Burn-in.
- 3.7.3. Electromagnetic compatibility tests.
- 3.7.4. Safety tests.

### **4. EMC**

- 4.1. Introduction to electromagnetic compatibility.
- 4.1.1. Electromagnetic environment.
- 4.1.2. Basic concepts in EMC. -
- 4.1.3. Basic elements of the EMC.
- 4.2. Interference transmitters and receivers.
- 4.2.1. Sources of interference.
- 4.2.1.1. Sources of natural interference.
- 4.2.1.2. Artificial interference sources.
- 4.2.1.2. Semiconductors, sources of interference.
- 4.2.2. Susceptibility of electronic circuitry.
- 4.2.3. The electronic components from the point of view of electromagnetic compatibility.
- 4.2.3.1. Conductors.



- 4.2.3.2. Resistors.
- 4.2.3.3. Capacitors.
- 4.2.3.4. Coils and transformers.
- 4.3. Interference mechanisms.
- 4.3.1. Galvanic coupling interference.
- 4.3.2. Electrical coupling of interference.
- 4.3.3. Magnetic coupling of interference.
- 4.4. Design techniques of electromagnetic compatibility.
- 4.4.1. Earth and mass.
- 4.4.1.1. The connection of the mass.
- 4.4.1.2. Wiring industrial systems.
- 4.4.1.3. Techniques for reducing ground loops.
- 4.4.2. Shielding of electronic systems.
- 4.4.2.1. Absorption losses.
- 4.4.2.2. Reflection losses.
- 4.4.2.3. Multiple reflections.
- 4.4.3. Filtering systems.
- 4.4.3.1. Network filters.
- 4.4.3.2. Output filters.
- 4.4.3.3. Filters with real components.
- 4.4.3.4. Common Mode Filters.
- 4.4.3.5. Differential mode filters.
- 4.4.3.6. Commercial filters.
- 4.4.4. Multilayer PCB Design.
- 4.4.4.1. Crosstalk in PCB. Positioning of the components.
- 4.4.4.2. Power distribution. Strategies of the ground planes and power.
- 4.4.4.3. Pathways.
- 4.4.4.4. Micro islands.
- 4.4.4.5. Noise in the dough.
- 4.4.4.6. Rule 20-H.
- 4.4.4.7. Rule 3-W.
- 4.4.4.8. Basic rules on power planes.
- 4.4.4.9. Distributions layers.
- 4.4.5. Design of Power Supply PCB.
- 4.5. EMC Solutions sub already mounted.

## **5. DESIGN DOCUMENTATION.**

- 5.1. Drafting of specifications
- 5.2. Design documentation
- 5.3. Production documentation
- 5.4. Plans, drawings and diagrams
- 5.5. And spare parts lists
- 5.6. Manuals and operating instructions
- 5.7. Test documentation
- 3.6. Cooling design.





## **6. PROTECTION AND DISTRIBUTION OF DESIGN**

6.1. Patent system: protection policies, patentability and infringement.

6.1.1. Introduction to IP-industrial (PI)

6.1.2. Key concepts relating to patents.

6.1.3. Requirements for patentability.

6.1.4. Protection of inventions.

6.1.5. Extension of protection to other countries.

6.1.6. Protection policy.

6.1.7. Interpretation of a patent document.

6.1.8. Patent infringement.

6.1.9. Some peculiarities.

6.2. Documentation: databases and information services technology patent offices (SPTO, EPO and others).

6.2.1. Information on the Internet.

6.2.2. Information technology services.

6.3. Transfer: transfer drafting contracts and licensing.

6.3.1. Brief introduction to the hiring

6.3.2. Technology transfer contracts.

6.3.3. Requirements for patentability.

6.3.4. Practical examples.

6.3.5. Anticompetitive rules.

6.4. Writing reports and claims.

6.4.1. Methodology claim drafting.

6.4.2. Special types of claims.

6.4.3. Formal and practical issues.

## **7. DPE laboratory**

1 Lab design and testing of electronic products.

2 Capacitive coupling between two parallel runways circuits.

3 Inductive coupling between circuits.

4 Shield of capacitive and inductive coupling.



## WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	8,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	37,00	0
Preparation of practical classes and problem	35,00	0
<b>TOTAL</b>	<b>150,00</b>	

## TEACHING METHODOLOGY

In theory classes will use the lecture model. The teacher will present on presentation and/or explain the contents of each issue to highlight those key aspects for understanding.

For practical laboratory sessions will be scheduled introduction activities to perform practice, development activities of experimentation and results analysis activities. Students will have scripts for practice and testing will be conducted entirely by them under the supervision of the teacher.

## EVALUATION

The evaluation of student learning will take place following two models:

### Type A:

Learning assessment of students attending at least 80% of classroom theory and lab-problems will be formative and will be carried out by continuous assessment of progress and the work developed throughout the course. This will take into account:

- Assessment of laboratory practices by:
  - The delivery, at the beginning of the lab sessions of the non-contact activities. The activities associated with non-contact practices are considered essential to successfully perform the same experimental setup.
  - The delivery of reports and questionnaires after each practice session.
- Participation in the class of problems in tutorials and in all planned activities and, second, solving activities (deliverables) that will be proposed in order to work independently (multiple choice tests, issues, problems numeric, seminars, exhibition of group work, etc ...).
- Exam, this will consist of several issues of theoretical and practical content related to the agenda, and equally difficult issues and problems done in class.



The student who do not pass the exam on the first official announcement should be submitted for consideration by the second call. Specifically, we propose the following quantitative model:

1. Participation in the lectures, problems and associated deliverables	33%
2. Performing laboratory practices and related deliverables	17%
3. Review of theory-problems	33%
4. Laboratory examination	17%

Hence, to pass the course is considered mandatory attendance at all laboratory sessions and receive a grade of not less than 4 out of 10 on tests.

**Type B:**

Those students not to attend at least 80% of total classroom throughout the course or who wish to express, will be assessed against an alternative model that is specified as follows:

1. Review of theory-problems	50%
2. Laboratory examination	25%
3. Deliverables of theory-problems and laboratory	25%

Hence, to pass is considered mandatory to obtain a mark higher than or equal to 4 of 10 on each exam.

The evaluation on the second call is only possible through the mode B

## REFERENCES

### Basic

- Referència b1: Esteve, V., Jordán, J.: Equipos Electrónicos, Moliner 40 editores.

Referència b2: Balcells, J., Daura, F., Esparza, R., Pallás, R.: Interferencias Electrónicas en Sistemas Electrónicos, Marcombo, Barcelona, 1992.

Referència b3: Chua, C. K., Leong, K. F., Lim, C. S.: "Rapid prototyping: principles and applications", 2nd ed., World Scientific, NJ 2004.

### Additional

- Referència c1: Fowler, K. R.: Electronic Instrument Design, Oxford University Press. New York, 1996. ISBN 0-19-508371-7.

Referència c2: Ulrich, K. T., Eppinger, S. D.: "Product design and development", 3rd ed., McGraw-Hill-Irwin, NY 2004.





Referència c3: Pàgina web oficial de la Oficina Española de Patentes y Marcas: [www.oepm.es](http://www.oepm.es)

