Course guide
330104 - EA - Analogue Electronics

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Delis Ramos, Francisco Manuel

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge of the fundamentals and applications of analog electronics.
2. Ability to design analog electronic systems.

Transversal:
4. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
5. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
3. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

TEACHING METHODOLOGY

The subject offers a continuous combination of the theoretical and the practical, individual and group work, and directed, guided and independent learning. Lectures, practical classes, using a computer for simulations and searching for information, and exercise-solving classes are some of the teaching methods followed to teach the topics. As far as possible, less weight is given to lecturers than to other, more active methods that allow for more independent learning. Students' independence is an important factor that must be developed and will be worked on in the subject. Acquiring this competency will not just be useful to pass the subject, it will also be useful later on, as it will help future engineers to adapt to changing environments in which a capacity for learning and problem solving will add to their professional competence.

The course aims to foster group work. Students will form pairs to work on the activities. Group work will take place in the classroom, in laboratory sessions, in the form of solving simulation or physical practical activities, and outside it, when students prepare the aforementioned practical activities or write reports on the work they have done.

There will also be room for individual work. Exercises, simulations, preparing for topics that will be covered in class by studying support materials (lecture notes, videos, simulations, etc.) and responding to questionnaires on the topic are designed to cover this aspect of students' work.

The subject is structured around the virtual teaching and learning platform Atenea, where all of the teaching material can be found and from which students are monitored and assessed. The source of much of the material is universities' OpenCourseWare (OCW), an excellent source of teaching material that is accessible to all and can be consulted after the subject has ended. In Atenea, the activities that must be completed will be presented and questions will be solved in the forums; it acts as a common space for communication between students and professors.

LEARNING OBJECTIVES OF THE SUBJECT

On completion of the subject Analogue Electronics, students must be able to:

- Demonstrate that they are acquainted with the basic principles of how analogue components and systems work.
- Analyse and design analogue circuits with general-use electronic components.
- Identify and use the components and integrated circuits that are commonly used in analogue electronics.
- Measure analogue systems and circuits correctly.
- Use tools appropriately for analysing and designing analogue circuits and systems.
-Use electronic equipment appropriately to experiment with analogue circuits and systems.
- Use electronic simulation tools.
- Write technical reports.
- Solve problems as they arise with initiative, autonomy and teamwork.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Topic 1: DIODE CIRCUITS

Description:
1.1. Electrical properties of semiconductors.
1.2. Diode characteristics
1.3. Rectifier circuits
1.4. The zener diode. Stabilizing circuits
1.5. Linear power supplies
1.6. Other circuits with diodes: clippers, voltage multipliers ...

Specific objectives:
- Demonstrate knowledge of the principal characteristics of semiconductor materials.
- Identify different types of diodes and demonstrate knowledge of their characteristics.
- Analyse and design rectifier and stabiliser circuits.
- Demonstrate an understanding of a linear power supply.
- Assemble a linear power supply.
- Measure a linear power supply.

Related activities:
- Assignment (LL). Tests on diode circuits.
- Assignment (LL). Exercises on diode circuits.
- Practical (PR). Introduction to electronic circuit simulation.
- Practical (PR). Simulation of a linear power supply.
- Practical (PR). Assembly of a linear power supply.
- Written test 1 (PE). Diode and bipolar transistor circuits.

Full-or-part-time: 39h
Theory classes: 8h
Laboratory classes: 8h
Self study : 23h

Topic 2: BIPOLAR TRANSISTORS

Description:
2.1. Characteristics of bipolar junction transistors (BJTs).
2.2. Polarisation of BJTs.
2.3. Cut-off and saturation.
2.4. Small-signal models.
2.5. BJT amplifiers.

Specific objectives:
- Demonstrate knowledge of the structure, characteristics and functioning of bipolar transistors.
- Use models to analyse and design bipolar transistor circuits.
- Analyse and design bipolar transistor circuits.
- Assemble bipolar transistor amplifier circuits.
- Measure bipolar transistor amplifier circuits.

Related activities:
- Assignment (LL). Tests on bipolar transistor circuits.
- Assignment (LL). Exercises on bipolar transistor circuits.
- Practical (PR). Simulation of a three-stage transistor amplifier.
- Practical (PR). Assembly of a three-stage transistor amplifier.
- Written test 1 (PE). Diode and bipolar transistor circuits.

Full-or-part-time: 39h
Theory classes: 8h
Laboratory classes: 8h
Self study : 23h

Topic 3: FIELD EFFECT TRANSISTORS

Description:
3.1. Characteristics of junction-gate field-effect transistors (JFETs).
3.2. Polarisation of JFETs.
3.3. Small-signal model.
3.4. Field-effect transistor amplifiers.
3.5. Field-effect transistor switches.

Specific objectives:
- Demonstrate knowledge of the structure, characteristics and functioning of field-effect transistors.
- Analyse and design field-effect transistor circuits.
- Use models to analyse and design field-effect transistor circuits.

Related activities:
- Assignment (LL). Tests on field-effect transistor circuits.
- Assignment (LL). Exercises on field-effect transistor circuits.
- Practical (PR). Simulation of JFET functioning.
- Written test 2 (PE). Field-effect transistor and operational amplifier circuits.

Full-or-part-time: 23h
Theory classes: 4h
Laboratory classes: 4h
Self study : 15h

Topic 4: OPERATIONAL AMPLIFIERS

Description:
4.1. Differential Amplifier
4.2. Characteristics of ideal and real operational amplifiers.
4.3. Linear circuits.
4.4. Non-linear circuits.
4.5. Active filters.

Specific objectives:
- Demonstrate knowledge of the structure, characteristics and functioning of operational transistors.
- Analyse and design basic linear and non-linear operational amplifier circuits.
- Analyse and design active filters.

Related activities:
- Assignment (LL). Tests on operational amplifier circuits.
- Assignment (LL). Exercises on operational amplifier circuits.
- Practical (PR). Simulation of a differential amplifier.
- Practical (PR). Assembly of operational amplifier application circuits.
- Written test 2 (PE). Field-effect transistor and operational amplifier circuits.

Full-or-part-time: 52h
Theory classes: 12h
Laboratory classes: 10h
Self study : 30h

ACTIVITIES

ACTIVITY 1: CLASS GROUP ACTIVITIES IN THE CLASSROOM

Description:
Various types of classes: lectures, query solving, exercise correction, problem solving, etc.

Specific objectives:
As stated in the specific objectives in the subject's topics.

Material:
Available at Athena

Delivery:
There is no direct relation between classes and assessment, although related activities such as assignments and practicals may take place during the classes.

Full-or-part-time: 30h
Theory classes: 30h

ACTIVITY 2: ASSIGNMENTS (LL)

Description:
The deliveries can be exercises of a different nature: tests, problems, simulations, search for component values, description of components or circuits, ... The idea is that they are activities to be carried out continuously during the semester so that students have permanent contact with the subject.

Specific objectives:
As stated in the specific objectives in the subject's topics.

Material:
Available in the corresponding Athena course

Delivery:
Referred to in the topics as LL.

Assignments are classed as submitted (OK), partially submitted (PP) or not submitted (NP), except tests, which are given a mark from 0 to 10. The final mark for assignments is a mark from 0 to 10.

Assignments make up 10% of the final mark for the subject.

Full-or-part-time: 15h
Self study: 15h

ACTIVITY 3: PRACTICALS (PR)

Description:
They may be simulation or laboratory practicals, written assignments, etc.

Specific objectives:
As stated in the specific objectives in the subject's topics.

Material:
Available in the corresponding Athena course

Delivery:
Referred to in the topics as PR.

Practicals are marked using rubrics that take into account whether the practical's specifications have been fulfilled, the report on the practical, the degree of autonomy with which the assigned task is carried out and teamwork. The final mark for the practical is a mark from 0 to 10.

Practicals make up 30% of the final mark for the subject.

Full-or-part-time: 80h
Practical classes: 30h
Self study: 50h

ACTIVITY 4: WRITTEN TESTS (PE)

Description:
During the semester there are two written tests, one held mid-semester and the other at the end of the semester (tests, problem solving, description of specific topics, etc.), plus a final exam for students who have not passed the subject over the course of the semester.

Specific objectives:
As stated in the specific objectives in the subject's topics.

Material:
Available in the corresponding Athena course

Delivery:
Referred to in the topics as PE.

During a regular semester there are two written tests, one held mid-semester and the other at the end of the semester, as stated in the description. They are awarded a mark from 0 to 10. The tests last two hours.

PE1: diodes + bipolar transistors + components and integrated circuits: 50% of the weight of the written tests in a regular semester.
PE2: field-effect transistors + operational amplifiers + components and integrated circuits: 50% of the weight of the written tests in a regular semester.

Mark for the written tests (regular semester) = 0.5*PE1 + 0.5*PE2

Students who do not pass the subject over the course of the semester may take a final exam (PEF), which will take place during the final exam period and will last two hours. This final exam covers all the topics taught during the semester and has a weight of 40% of the mark for written tests. In this case:

mark for the written tests (with the final exam) = 0.3*PE1 + 0.3*PE2 + 0.4*PEF

The written tests (PE) represent 60% of the mark for the subject.

Full-or-part-time: 27h
Theory classes: 6h
Self study: 21h

GRADING SYSTEM

The final mark for the subject is the weighted average mark for assignments, practicals and written tests, which is calculated as follows:

FINAL MARK = 0.1*LL + 0.3*PR + 0.6*PE

The subject is considered to have been passed when the final mark is equal to or greater than 5.

EXAMINATION RULES.

- If any of the activities is not done, a mark of 0 is awarded.
- Not all of the activities must be completed, but the final mark for the subject must be equal to or greater than 5.
- In group activities, not all of the members of the group need be awarded the same mark. The mark depends on the degree of involvement of each member of the group in the activity, on the task they carry out, etc.
- For practicals, student must have, at least, their own breadboard, multimeter and oscilloscope probe. They are also advised to have their own set of basic tools, including a screwdriver, pliers and a wire cutter.

BIBLIOGRAPHY

Basic:
- Malvino, Albert P. Principios de electrónica [on line]. 7ª ed. Madrid: McGraw-Hill, 2007 [Consultation: 03/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4146. ISBN 9788448156190.
- Hambley, Allan R. Electrónica [on line]. 2ª ed. Madrid: Prentice Hall, 2001 [Consultation: 10/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1318. ISBN 8420529990.

Complementary:
- Fiore, James J. Amplificadores operacionales y circuitos integrados lineales. Madrid: Thomson, 2002. ISBN 8497320999.
- Malik, Norbert R. Circuitos electrónicos: análisis, diseño y simulación. Madrid: Prentice Hall, 1996. ISBN 8489660034.

RESOURCES

Other resources:
All the material needed to follow the subject is available in the subject's ATENEA environment.