Universitat Autònoma de Barcelona

2019/2020

Electronics

Code: 100187
ECTS Credits: 6

Degree	Type	Year	Semester
2500097 Physics	OT	4	2

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Xavier Cartoixa Soler

Prerequisites

Basic knowledgements of electromagnetism, statistical physics and quantum physics. For some concepts, it would be useful that you have followed a course on solid-state physics, but this is not actually a requirement.

Objectives and Contextualisation

Obtain some basic knowledge of semiconductor physics. Study de physical of electron devices and their applications in electronic circuits. Understand the physics behing the function of electron devices. Have a first contact with linear circuit analysis, the concept of equivalent circuit and some practical examples of real use. First contact with active circuit elements and their application in analog and digital signal electronics. Fist contact with the implementation of logic functions and with digital memory and storage systems.

Competences

- Apply fundamental principles to the qualitative and quantitative study of various specific areas in physics
- Be familiar with the bases of certain advanced topics, including current developments on the parameters of physics that one could subsequently develop more fully
- Carry out academic work independently using bibliography (especially in English), databases and through collaboration with other professionals
- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics
- Develop critical thinking and reasoning and know how to communicate effectively both in the first language(s) and others
- Develop independent learning strategies
- Formulate and address physical problems identifying the most relevant principles and using approximations, if necessary, to reach a solution that must be presented, specifying assumptions and approximations
- Generate innovative and competitive proposals for research and professional activities.

- Plan and perform, using appropriate methods, study, research or experimental measure and interpret and present the results.
- Respect the diversity and plurality of ideas, people and situations
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation
- Using appropriate methods, plan and carry out a study or theoretical research and interpret and present the results
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project
- Working in groups, assume shared responsibilities and interact professionally and constructively with others, showing absolute respect for their rights.

Learning Outcomes

1. Analyse and describe the characteristics and applicability of certain basic electronic circuits.
2. Calculate currents and voltages in the various reports of an electronic circuit based on the characteristics of its components.
3. Calculate currents and voltages of an electronic device from its technological features.
4. Characterize basic electronic devices.
5. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
6. Construct certain basic electronic circuits through the interconnection of different devices.
7. Describe the fundamentals of semiconductor physics and their relationship to electronic devices.
8. Describe the role of materials science and nanotechnology in the technological evolution of electronic devices.
9. Design and describe the basic characteristics of an electrical circuit and its potential applicability.
10. Develop critical thinking and reasoning and communicate ideas effectively, both in the mother tongue and in other languages.
11. Develop independent learning strategies.
12. Generate innovative and competitive proposals for research and professional activities.
13. Identify the technological limits of integrability and scalability of electronic devices and systems.
14. Obtain equivalent circuit models and devices for the analysis of complex electronic systems.
15. Respect diversity in ideas, people and situations.
16. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
17. Use differential equations and complex numbers in the study of the characteristics of electronic devices and circuits.
18. Use essential electronic instrumentation to analyse basic circuits.
19. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.
20. Working in groups, assume shared responsibilities and interact professionally and constructively with others, showing absolute respect for their rights.
21. Carry out academic work independently using bibliography (especially in English), databases and through collaboration with other professionals

Content

• Introduction to basic semiconductor physics

• Analog systems: Kirchoff laws, Thévénin and Norton theorems, circuit analysis.

• Operational amplifier.

• PN junction diode.

• Bipolar Junction Transistor.

• MOS capacitance and MOSFET

• Digital Electronics

Methodology

Methodology consists in a combination of class lessons, exercise solution in class and autonomous laboratory work

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Excercise solution in class and laboratory work	19	0.76	1, 3, 2, 4, 5, 6, 11, 9, 21, 14, 16, 19, 20, 18, 17
Lessons	30	1.2	1, 3, 8, 7, 9, 13, 14, 16, 15, 17
Type: Autonomous			
Homework independent solution and preparation of laboratory practice	42	1.68	1, 3, 2, 4, 5, 6, 11, 10, 9, 21, 14, 16, 15, 19, 20, 18, 17
Personal study of course contents	50	2	1, 8, 7, 10, 9, 12, 13, 16, 19

Assessment

Lboratory classes are compulsary and a prerequisite to pass the course.

There will be two partial examen, one after half of the course and another one at the end. The mark of laboratory work will only be accounted for when the average of partial exam marks exceeds 4/10.

A final exaen covering all the content of the course will be offered to student who do not pass the course after having presented laboratory work and the two partial exams, they do not reach the required level to pass the course. Having presented laboratory reports, and after having presented the two partial exams is a requirement to participate in the final exam.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam for the first half of the course	37,5%	3	0.12	1, 3, 2, 8, 7, 9, 12, 13, 14, 19, 17
Final examen (those who have failed continuous evaluation)	75%	3	0.12	1, 3, 2, 8, 7, 9, 12, 13, 14, 17
Laboratori classes	25%	0	0	1, 4, 5, 6, 11, 10, 9, 21, 16, 15, 20, 18
Second partial exam	37,5%	3	0.12	1, 3, 2, 8, 7, 9, 12, 13, 14, 19, 17

Bibliography

Basic course bibliography

Circuits i dispositius electrònics: fonaments d'electrònica, Lluís Prat Viñas *et al.*, Edicions UPC, 1998.

Physics of Semiconductor Devices, Michael Shur, Prentice Hall Series in Solid State Physical Electronics, 1990.

Física de los Semiconductores, K.V. Shalímova, Editorial Mir, 1975.

Instrumentación electrónica, M.A. Pérez, J.C. Álvarez, J.C. Campo, F.J. Ferrero, G.J. Grillo, Thomson, 2004.

Other books of Interest

Semiconductor Devices: Physics and Technology, Simon M. Sze, John Wiley & Sons, 2001.

Electrónica de los dispositivos para circuitos integrados, R.S. Muller, T.I. Kamins, Ed. Limusa.

Fundamentos de microelectrónica, nanoelectrónica y fotónica, J.M. Albella Martín, Pearson Educación, 2005.

Physics of Semiconductor Devices, S. M. Sze, John Wiley and Sons, 3rd Ed. 2007.

Electronics of Measuring Systems, Tran Tien Lang.