COURSE SYLLABUS

Academic Year: 2020/2021

Identification and characteristics of the course				
Code	501097	ECTS Credits	6	
Course title (English)	Electronic technology			
Course title (Spanish)	Tecnología electrónica			
Degree programs	Degrees in electronics and automation engineering and mechanical engineering (industrial branch)			
Faculty/School	Industrial Engineering School			
Semester	5º	Course type (compulsory/optional)	Compulsory	
Module	Specific Technology of Industrial Electronics and Automation Optional			
Subject matter	Electronics Diversification in Industrial Electronics and Automation			
Lecturer/s				
Name		Room	E-mail	Web page
Ausín Sánchez, José Luis		D1.8	jlausin@unex.es	http://campusvirtual.unex.es
Carrillo Calleja, Juan Manuel		D1.6	jmcarcal@unex.es	http://campusvirtual.unex.es
Subject Area	Electronic Technology			
Department	Electrical, Electronic and Automatic Engineering			
Coordinator (Only if there is more than one lecturer)	Ausín Sánchez, José Luis			

Competencies*
1. Basic competences (CB):
CB1. To demonstrate that the knowledge has been acquired and understood, within a study area that includes contents starting from a high school level, and includes knowledge of advanced books, but also includes updated and innovating concepts.
CB2. To apply the knowledge to a job, and acquired the skills that can be demonstrated by the development and description of arguments and resolution of problems, in the area of study.
CB3. To acquire the skill of interpreting relevant data (within the area of study) to asses judgements including a reflexion on relevant issues of social, scientific and ethical character.
CB4. To transfer information, ideas, problems and solutions to a specialized and nonspecialized public.
CB5. To develop learning skills needed to undertake further studies with a high degree of autonomy
2. General competences (CG):
CG1. Ability to write, sign and develop projects in the field of Electrical / Industrial Electronics and Automatic / Mechanical Engineering, whose purpose is the construction, reform, repair,

*The sections concerning competencies, course outline, teaching activities, teaching methodology, learning outcomes and assessment methods must conform to those included in the ANECA verified document of the degree program.

conservation, demolition, manufacture, installation, assembly or exploitation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and facilities, and manufacturing and automation processes.
CG2. Ability to direct the activities that are the object of the engineering projects described in CG1.
CG3. Knowledge of basic and technological subjects, which enables them to learn new methods and theories, and equips them with versatility to adapt to new situations.
CG4. Ability to solve problems with initiative, creativity, critical reasoning, for decision-making and to communicate and transmit knowledge, abilities and skills in the field of Electrical / Industrial Electronics and Automatic / Mechanical Engineering.
CG5. Ability to carry out tests, measurements, calculations, surveys, studies, reports, and other similar works in the field of Electrical / Industrial Electronics and Automatic / Mechanical Engineering.
CG6. Ability to manage specifications, regulations and mandatory standards.
CG7. Ability to analyze and assess the social and environmental impact of technical solutions.
CG8. Ability to apply the principles and methods of quality.
CG9. Organizational and planning capacity within the company, and other institutions and organizations.
CG10. Ability to work in a multilingual and multidisciplinary environment.
CG11. Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer, specialty Electricity / Industrial Electronics and Automatic / Mechanical.
2. Transversal Competences (CT):
CT1. To get the knowledge on basic and technological subjects, allowing to the inclusion of new methods and theories, and gives versatility to be adapted to new situations.
CT2. To solve problems and to take decisions with initiative, creativity and critical thinking.
CT3. To communicate and transfer knowledge, abilities in the field of engineering.
CT4. To find, analyze, criticize, relate, structure and synthesize scientific and technical information from different sources.
CT5. To apply information and communication technologies.
CT6. To have motivation in regards to motivation and continuous improvement.
CT7. To be able to effectively communicate in other languages, mainly in English.
CT8. To have an ethical, responsible and respectable attitude with people and environment.
CT9. To be able to work efficiently in multidisciplinary teams assuming different roles and responsibilities with absolute respect to the fundamental rights of equality between men and women.
CT10. Ability to analyze and assess the social and environmental impact of technical solutions.
3. Specific Competences (CETE);
CETE6. Ability to design analog, digital and power electronic systems.
Contents
Course outline*
Study of functional and constructive characteristics of passive and active electronic components, printed circuits, and introduction to the design of integrated circuits.
Course contents
Title of unit 0: **Course presentation and initial evaluation (1 hour)** Contents of unit 0: Course presentation and previous knowledge (1 hour)
Title of unit 1: **Semiconductor diodes (9 hours)** Contents of unit 1: Theory (4 hours): 1.1. Semiconductor materials 1.2. The pn junction 1.3. The diode: operation and equivalent circuits

1.4. Diode Applications 1.5. Special purpose diodes Problems (1 hour) Electronic circuit simulation (2 hours): O1. PSpice tutorial Laboratory practices (2 hours): L1. Diode characterization
Title of unit 2: **Bipolar Junction Transistor (9 hours)** Contents of unit 2: Theory (5 hours): 2.1. Device structure and physical operation 2.2. Current-voltage characteristics 2.3. DC operation and polarization 2.4. Small signal equivalent model 2.5. Internal capacities and high-frequency model Problems (2 hours) Laboratory practices (2 hours): L2. BJT amplifier stage
Title of unit 3: **MOS Field-Effect Transistor (11 hours)** Contents of unit 3: Theory (5 hours): 3.1. Field-Effect Transistors (FETs) 3.2. MOSFET structure and physical operation 3.3. Current-voltage characteristics 3.4. DC operation and MOSFET polarization 3.5. Small Signal Equivalent Model 3.6. Internal capacitances and high-frequency model Problems (2 hours) Laboratory practices (4 hours): L3. Characteristic parameters of MOS transistor L4. MOSFET Amplifier Stage
Title of unit 4: **Power Semiconductor Devices (3 hours)** Contents of unit 4: Theory (2 hours): 4.1. Power diodes 4.2. Power transistors: BJT, MOSFET, IGBT 4.3. Thyristors: diacs, triacs, IGCT, SCR, GTO Problems (1 hour)
Title of unit 5: **Passive Devices (3 hours)** Contents of unit 5: Theory (3 hours): 5.1. Conductive materials. Resistances: construction technologies. 5.2. Dielectric materials. Capacitors: construction technologies. 5.3. Magnetic materials. Inductors: construction technologies.
Title of unit 6: **Printed Circuit Board Technology (10.5 hours)** Contents of unit 6: Seminar (2 hours): 6.1. Introduction to printed circuit board 6.2. Introduction to surface mount technology 6.3. Basics of printed circuit board manufacturing 6.4. Assembly technology on printed circuit boards 6.5. EMI: design tips

Electronic circuit simulation (2 hours):
O2. Eagle tutorial
Laboratory practices (6.5 hours):
L5. PCB manufacturing
L6. Tutored project based on the design of a printed circuit board

Title of unit 7: **Integrated Circuit Technologies (3 hours)**
Contents of unit 7:
Theory (1 hour):
7.1. CMOS fabrication steps
7.2. Integrated devices: passive, diodes, and MOSFET transistors
Seminars (2 hours):
S2. Integrated circuit design and layout methodology

Educational activities *

Student workload (hours per lesson)		Lectures	Practical sessions				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
0	2	1						1
1	21.5	5		2	2		0.5	12
2	25.5	7		2			0.5	16
3	28.5	7		4			0.5	17
4	13.5	3					0.5	10
5	8	3						5
6	27	0		6.5	2	2	0.5	16
7	10.5	1				2	0.5	7
Assessment ** *	13.5	3						10.5
TOTAL ECTS	150	30	0	14.5	4	4	3	94.5

L: Lectures (100 students)
HI: Hospital internships (7 students)
LAB: Lab sessions or field practice (15 students)
COM: Computer room or language laboratory practice (30 students)
SEM: Problem-solving classes, seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching Methodology*

Among the teaching methodologies included in the bachelor degree program, the following are used in this course:

Teaching methodologies	Used are indicated with an "X"
1. Explanation and discussion of theoretical contents	X
2. Resolution, analysis and discussion of support examples and problems previously proposed	X
3. Presentation of works previously assigned to the students	X
4. Development of practical cases in the lab, computers room, field, etc.	X
5. Resolution of doubts in reduced groups, in order to detect possible problems in the teaching/learning process and advice regarding works, labs and personal study of the student	X

** Insert as many rows as necessary. For instance, you can include one row for a partial exam and another for the final exam.

6. Search of information, previous to the development of a chapter or complementary after realizing the corresponding activities	X
7. Elaboration of works, individually or in groups	X
8. Study of each chapter, which may consist in: study of contents, training with problems and cases, training for the exam, etc.	X

Lessons and theoretical discussions, problems resolution and theoretical/practical cases will be carried out in the **lectures**.

Seminars will be held in the location assigned to this type of activity and the expected schedule will be included in the semester's agenda.

Assembly and test of electronic circuits, also supported by CAD activities, will be carried out in **labs and computer room lessons**. Practical lessons have associated personal work of the student, both previous to the face-to-face sessions (prelab), so that students become familiar with the contents, as well as after each session, for the drawing and writing of conclusions from the obtained results.

The **advised project** consists of a face-to-face part in the lab and a personal part, in which the student will carry out a previous preparation, with the help of the appropriate bibliography, and will finish the project by writing a report with the most significant results obtained during the realization of the activity.

Learning outcomes *

- Knowing the different devices and electronic components of general use in the industrial environment.
- Knowing the processes involved in the manufacture of integrated circuits individually, as well as their integration to obtain a certain active device.
- Becoming familiar with the use of CAD tools for circuit simulation, geometric edition of masks and design of printed circuit boards.
- Managing laboratory equipment for test and verification of circuits and manufacturing of printed circuit boards.

Assessment methods *

Assessment criteria

The course will be assessed according to the following criteria:

CE1. Domain of theoretical contents.
Related to competences CB1, CB5, CG3, CT1, CETE6.

CE2. Knowledge of practical procedures.
Related to competences CB2, CB5, CG4, CT2, CETE6.

CE3. Ability to apply the knowledge acquired in the resolution of practical cases.
Related to competences CB3, CB5, CT4, CETE6.

CE4. Domain of CAD and lab tools related to the subject.
Related to competences CB5, CT5, CETE6.

CE5. Ability to communicate and transmit knowledge in an appropriate technical language, oral and written, within the field of the electronic technology.
Related to competences CB4, CB5, CT3, CT7, CETE6.

CE6. Acquisition of skills related to realization of a project based on a real case.
Related to competences CB2, CB5, CG1, CG2, CG4-CG11, CT6, CT8-CT10, CETE6.

Assessment activities

Among the assessment activities included in the bachelor degree program, the following are used in this course:

	Range established	Ordinary call	Extraordinary call	Global assessment

1. Theoretical/practical final exam and/or eliminatory partial exams.	0%–80%	60%	60%	80%
2. Practical activities carried out in: classroom, laboratory, computer room, field, visits, etc.	0%–50%	10%	10%	10%
3. Resolution and submission of activities (cases, problems, reports, works, projects, etc.), individually and/or in groups (L, SL, SGT).	0%–50%	15% + 15%	15% + 15%	10%
4. Active participation in class.	0%–10%	0%	0%	
5. Assistance to face-to-face activities.	0%–10%	0%	0%	

Description of assessment activities

The criteria indicated previously will be assessed by means of the following activities:

AE1. WRITTEN TEST (related to activity 1. in the table)

It will be held in the examinations period and the contents of seminars can also be evaluated. To pass the course, it will be necessary to obtain a grade of at least 4, being 60% its contribution to the final grade. This activity is RECOVERABLE in the extraordinary call, with the same weight of 60% of the final grade. In case the course is not passed in the ordinary call, the grade of this evaluation activity will only be maintained for the extraordinary call if it is equal to or greater than 5.

AE2. LABS AND COMPUTER ROOM LESSONS (related to activity 2. in the table)

Attendance at labs and computer room lessons is compulsory. Students who take advantage of practical sessions will have a passing grade. In addition, these students will submit a report with the results and conclusions of the labs L1 to L4 within the two weeks after being held, which may report up to 10% of the final grade. The unexcused absence in more than one lab and computer room lesson will entail the obligation of the student to face a practical exam, which must be passed in order to pass the course, without reporting any contribution to the final grade. This activity is considered NON-RECOVERABLE, that is, it cannot be carried out in the extraordinary call, even though the corresponding grade obtained in the ordinary call will be added in the extraordinary call. In this call, the student must pass a practical exam, although, as in the ordinary call, it won't have any contribution to the final grade.

AE3. FOLLOW-UP TASKS (related to activity 3. in the table)

The student will have to carry out different tasks throughout the course, being the contribution of this activity 15% of the final grade. These activities are classified as NON-RECOVERABLE. However, if the student has submitted them during the ordinary call, the grade obtained will be added, if applicable, to the final grade in the extraordinary call, with the same weight of 15% of the final grade.

AE4. DEVELOPMENT OF AN ADVISED PROJECT (related to activity 4. in the table)

The student will have to submit a memory where the project carried out is described. This report must deal with the development of an electronic technology project. Attendance at face-to-face project sessions is mandatory. It

is compulsory to include the design of a printed circuit board (PCB) in the project to pass this part of the course, as all the contents related to PCBs are exclusively assessed through this activity. The project will have a weight of 15% in the student's final grade, being a RECOVERABLE assessment activity.

If the mark obtained in the exam (AE1) is lower than the minimum required to pass the course, the final grade will be 4.9 if it is equal to or greater than 5 and the final grade itself on the contrary.

The global assessment will take place the same day assigned to the final exam of each call. It will consist of the following parts:

- Written part: written test with theoretical/practical questions and/or problems, with a weight of 80% in the final grade.
- Practical part: assembly and explanation by the student of a lab, which computes with 10% in the final grade.
- Design part: test in which the student must demonstrate the handling of simulation and PCB edition tools used in the course, whose contribution to the final grade is 10%.

Bibliography (basic and complementary)

Basic bibliography

B1. Microelectronic circuits (6th ed.), A.S. Sedra, K.C. Smith, Oxford Univ. Press, 2011.

B2. Electronic devices (8th ed.), T.L. Floyd, Prentice Hall, 2008.

Complementary bibliography

C1. Eelectronic devices and circuit theory (8th ed.), R.L. Boylestad, L. Nashelsky, Prentice Hall, 2002.

Electronic version available in the Electronic Library of UEx.

C2. Electronic principles (7th ed.), A. Malvino y D.J. Bates, McGraw-Hill, 2007.

C3. Electronics (2nd ed.), A.R. Hambley, Prentice Hall, 2001.

Electronic version available in the Electronic Library of UEx.

C4. Electronic circuits: analysis, simulation, and design, N.R. Malik, Prentice Hall, 1996.

C5. Electronic technology: materials and fabrication techniques, A. Bandera, J.A. Rodríguez, F.J. Sánchez, University of Málaga, 2002.

Other resources and complementary materials

Web pages

W1. Virtual Campus of the University of Extremadura: http://campusvirtual.unex.es.

W2. Eagle docs and tutorials: https://www.autodesk.com/products/eagle/overview.

W3. OrCAD resources and tutorials: http://www.orcad.com/

W4. Electronic Engineers Community: http://www.element14.com.