



IDENTIFYING DATA

Advanced Design of Industrial Electronic Systems

Subject	Advanced Design of Industrial Electronic Systems			
Code	V04M141V01207			
Study programme	(*)Máster Universitario en Enxeñaría Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Marcos Acevedo, Jorge Nogueiras Meléndez, Andres Augusto			
Lecturers	López Sánchez, Óscar Nogueiras Meléndez, Andres Augusto			
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General description	<p>In this subject, the fundamental concepts on reliability (RAMS) of components and electronic systems are taught, as well as the techniques to be applied to make a system to fulfill the RAMS specifications. Also the basic concepts on electromagnetic compatibility are addressed, and the sources of electromagnetic interference and its minimization.</p> <p>English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.</p> <p>This is a translated version of the subject guide. In case of any discrepancy, the only one valid is the Spanish one.</p>			

Skills

Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
A2	That the students can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
C1	CET1. Project, calculate and design products, processes, facilities and plants.
C5	CET5. Technically and economically manage projects, installations, plants, companies and technology centers.
C11	CET11. Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Engineer.
C18	CTI7. Ability to design electronic and industrial instrumentation systems.
D1	ABET-a. An ability to apply knowledge of mathematics, science, and engineering.
D3	ABET-c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D9	ABET-i. A recognition of the need for, and an ability to engage in life-long learning.

Learning outcomes

Expected results from this subject	Training and Learning Results
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Capacity for the analysis, design and implantation of electronic systems	A1 A2 C1 C18 D1 D3
Capacity to apply the technologies of confiabilidad (RAMS) to the electronic systems.	A1 A2 C1 C5 C18 D1 D3
Knowledge of the sources of interferencias electromagnetic in electronic systems.	A2 C11 C18 D1 D3 D9
Capacity for minimizar the effects of the interferencias electromagnetic in electronic systems of potencia, digital electronic systems and electronic circuits of communications.	A1 A2 C1 C5 C11 C18 D1 D3
Capacity to apply the rule on electromagnetic compatibility	A1 A2 C1 C11 C18 D1 D3 D9

Contents

Topic	
Electromagnetic interferences	Noise and interference. Design for electromagnetic compatibility (ECM). Path of electromagnetic noise. Coupling methods.
Design techniques for EMC	Analysis of conducted emissions. Analysis of radiated emissions. Common impedance coupling. Cabling. Ground system. Shielding.
EMC standards for industrial equipment	EMC directive 2014/30/UE. EMC basic publications. EMC generic standards. Product family standards. Emission and immunity standards, conducted and radiated. Harmonic currents standards. Grid disturbances standards. Precompliance EMC tests.
Introduction to the reliability of electronic systems	Definitions and basic concepts. RAMS Technologies. Parameters of the reliability of electronic components. Prediction of the reliability. Applicable technical standards. Systems in series, parallel and redundant.
Design and optimization of electronic systems	Optimization of redundancies. Analysis for maintainability and availability.
Analysis of failures	Modelling by Markov and by Petri networks. Failure modes of electronic components. Determination of mechanism and ways of failures.
Fail-safe systems	Specifications for safe systems against failures. Design methodologies for fail-safe systems.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	32	56
Autonomous problem solving	0	24	24
Objective questions exam	2	0	2
Laboratory practice	12	18	30
Systematic observation	0.5	0	0.5

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	These sessions will be held in the rooms and dates fixed by the direction of the school. They will consist in an oral explanation by the professor of the most important parts of the course, all related with the materials that the student had to work previously. This is intended to favor the active participation of the students, that will have occasion to rise doubts and questions during the sessions. Active participation is desired during all the sessions.
Autonomous problem solving	Self study and review of the theoretical sessions for knowledge consolidation: The student must study, in a systematic time schedule, after each lecture session, in order to dissipate any doubts. Any doubts or unsolved questions will have to be expose to the professor as soon as possible in order to enhance the feedback of the learning process.

Personalized assistance

Methodologies	Description
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Tests	Description
Laboratory practice	Laboratory sessions will be held in the time schedule established by the school's direction. Students will work in groups, possibly of two students each. The sessions will be supervised by a professor, who will control the assistance and will also evaluate the harnessing of it. During the laboratory session the students will make activities of the following kinds: - Assembling electronics circuits - Use of electronic instrumentation - Measure of physical variables on circuits - Do calculations related to the circuit and/or the measurements - Software calculations and model simulations.
Systematic observation	The professor will observe personally the behavior of the students during the the study of theoretical concepts, the resolution of problems, the practices of laboratory and the development of works. The students have to pay special attention to the attitude during all these activities.

Assessment

	Description	Qualification	Training and Learning Results		
Objective questions exam	The exam can consist of test type questions, of short questions and / or numerical problems.	68	A2	C1 C5 C11 C18	D1
Laboratory practice	The sessions will be given in the laboratories of the department, employing the instrumentation and the available teams. Also they will employ computer tools for the calculation and analysis.	27	A1 A2	C5 C18	D1 D9
Systematic observation	The professors of the subject will observe the attitude of each one of the students in the distinct tasks, also in the classes of theory and as in the laboratory sessions.	5			D1 D3 D9

Other comments on the Evaluation

All students, by default, will be evaluated continuously

Students who opt for non continuous assessment must request it from the center's direction.

Continuous assessment implies that the students:

- must carry out the proposed tasks during the laboratory sessions, during which they will be systematically observed.
- must take the exam with objective questions, which may include numerical exercises.

In the laboratory sessions, the score will be the same for all students who are in the same position, with the systematic observation that every one has individually.

In group work, the score of the work will be the same for all the members of the group, with the systematic observation that every one has individually.

All the tests will be valued out of 10 points, and in none of them can a grade of less than 3 points be obtained.

In case of obtaining a grade lower than three points, the test score becomes zero points.

Students who do not pass the subject at the first opportunity must sit an exam of objective questions in the second call. In this case, the qualifications obtained in the laboratory practices are preserved.

Those students who choose to waive continuous assessment must sit an exam with objective questions, that will be worth 100% of the note.

Ethical behavior is required of the student. In case of detection of plagiarism in any of the works/tests. Once the final grade for the subject has been completed, it will be "failed (0)" and the teachers will notify the school management the matter to take whatever action it deems appropriate.

Sources of information

Basic Bibliography

Department of Defense. USA, **MIL-HDBK-338. Electronic Reliability Design**, Departamento de Defensa Americano, 1988

P. Kales, **Reliability for technology, engineering and management**, Prentice-Hall, 1998

R. Ramakumar, **Engineering reliability. Fundamentals and applications**, Prentice-Hall, 1992

David J. Smith, **Reliability, Maintainability and Risk**, 8ª, Butterworth Heinemann, 2011

Dmitri B. Kececioglu, **Reliability Engineering Handbook**, DEStech, 2002

J. Balcells, F. Daura, R. Esparza e R. Pallás, **Interferencias Electromagnéticas en Sistemas Electrónicos**, Marcombo, 1991

N. Ellis, **Interferencias Eléctricas Handbook**, Paraninfo, 1998

M. I. Montrose, **Printed Circuit Board Techniques For EMC Compliance**, 2ª, John Wiley & Sons Inc, 2000

Michael D. Medoff Rainer and I. Faller, **Functional Safety: An IEC 61508 SIL 3 Compliant Development Process**, 3ª, Exida, 2014

Complementary Bibliography

T.I. Bajenescu, M.I. Bâzu, **Reliability of Electronic Components**, Springer-Verlag, 1999

Hoyland, M. Rausand, **System Reliability Theory: Models and Statistical Methods**, 2ª, Wiley-Interscience, 2004

Antonio Creus Solé, **Fiabilidad y seguridad: Su aplicación en procesos industriales**, Marcombo, 2005

P. Degauque y J. Hamelin, **Electromagnetic Compatibility**, Oxford University Press, 1993

Milton Ohring, **Reliability and Failure of Electronic Materials and Devices**, 2ª, Elsevier, 2015

Chris J. O'Brien, **Final Elements in Safety Instrumented Systems**, 1ª, Exida, 2018

Henry W. Ott, **Electromagnetic Compatibility Engineering**, 978-1-118-21065-9, 1ª, Wiley, 2011

Recommendations

Other comments

It is very important that students keep their profile updated on the subject's moovi platform, since any collective communication related to it will be made through the associated news forum.

Individual communications will be made through the personal email address that appears in the profile.

Students must inexcusably meet the deadlines established for the different activities.

In the different tests, students are advised to justify all the results they achieve.

It is recommended, in the presentation of the various exercises, in the practice reports and in the exams, not to present misspellings and illegible characters or symbols, because they will affect the final score. In the same way, the documentation that the students deliver must be done through word processing, spreadsheet, etc., but it is not valid to do it by hand and scan or photograph.

Notes cannot be used during the exams, and mobile phones must be turned off and put away at all times.