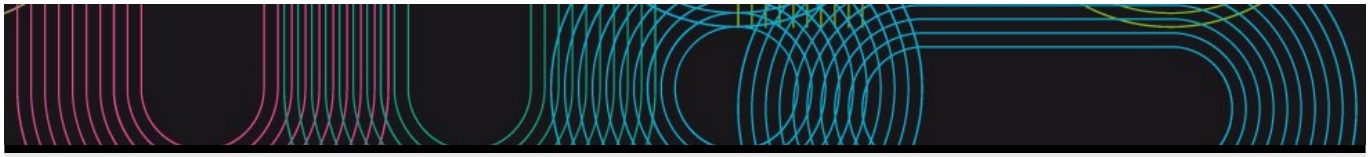

IDENTIFYING DATA				
Advanced Design of Industrial Electronic Systems				
Subject	Advanced Design of Industrial Electronic Systems			
Code	V04M141V01207			
Study programme	(*)Máster Universitario en Enxeñaría Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Nogueiras Meléndez, Andres Augusto			
Lecturers	López Sánchez, Óscar Nogueiras Meléndez, Andres Augusto			
E-mail	aaugusto@uvigo.gal			
Web	http://moovi.uvigo.gal/			
General description	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. 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. This is a translated version of the subject guide. In case of any discrepancy, the only one valid is the Spanish one.			

Training and Learning Results	
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.

Expected results from this subject	
Expected results from this subject	Training and Learning Results

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. Precompilance 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	12	12
Objective questions exam	2	0	2
Laboratory practice	12	18	30
Essay	0	12	12
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**
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.
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.
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 sessionsthe 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.
Essay	The professors will attend personally the doubts and queries of the students, on the development of the work. The students will have occasion to attend to personalised or groups tutoring sessions in the desk of the professors, in the schedule that establish for this effect to the beginning of the course and that will published in Moovi.

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.	34	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
Essay	The work [TP] proposed can be: participate in the translation of a technical standard; elaborate a report on an installation or an equipment; or evaluate the behaviour of equipments in accordance with a standard in the laboratory.	34	A1 A2	C5 C11 C18	D3 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

Laboratory sessions

In these sessions, the score will be the same for those who are in the same position, with the systematic observation score that each person individually has.

Group work (Essay)

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

Ordinary exam for continuous assessment

The final mark [NAEC] that will be on the record, is taken from the weighted sum of the laboratory practice, from the essay and assessment marks.

NAEC = 0.27 * NP + 0.34 * NT + 0,34 * TP + 0,05 * OS

Ordinary exam for global assessment

It will be necessary to sit a theoretical exam [NTEG], on the date established by the center for the ordinary exam, and a practical laboratory exam [NPEG], on a date to be agreed depending on the availability of laboratories and non-coincidence with other exams of the same course.

Each of these exams will be evaluated on a score of 10 points. If the theoretical exam is taken, and the student does not show for the practical, the [NPEG] grade will be zero (0,0).

The final mark that will go to the record [NAEG] will be the average of both exams. That is to say:

NAEG = (NTEG + NPEG) / 2

Extraordinary exam for continuous evaluation

In this call, the practical note and the essay note from the ordinary call will be kept, and it will be necessary to take the objective questions exam [NTE].

The grade that will go to the [NAEEC] minutes will be the weighted sum of the practical and exam grades.

NAEEC = 0.27 * NP + 0.34 * NTE + 0,34 * TP + 0,05 * OS

Extraordinary exam for global evaluation

It will be necessary to sit a theoretical exam [NTEEG], on the date established by the center for the ordinary call, and a practical laboratory exam [NPEEG], on a date to be agreed depending on the availability of laboratories and non-coincidence with other exams of the same course.

Each of these exams will be evaluated on a score of 10 points. If the theoretical exam is taken, and the student does not show up for the practical, the [NPEEG] grade will be worth 0.

The mark that will go to the record [NAEEG] will be the average of both exams. That is:

NAEEG = (NTEEG + NPEEG) / 2

End-of-degree exam

It will be necessary to sit a theoretical exam [NTFDC], on the date established by the center for the ordinary call, and a practical laboratory exam [NPFDC], on a date to be agreed depending on the availability of laboratories and non-coincidence with other exams of the same course.

Each of these exams will be evaluated on a score of 10 points. If the theoretical exam is taken, and the student does not show up for the practical, the [NPFDC] grade will be worth 0.

The mark that will go to the [NAFDC] record will be the average of both exams. That is:

NAFDC = (NTFDC + NPFDC) / 2

Ethical commitment

Whoever takes the subject is expected to have a correct ethical behavior. In the case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, and others) it will be considered that it does not meet the necessary requirements to pass the subject. In this case, the overall grade for this academic year will be fail (0.0) and the school authorities will be notified for the appropriate purposes.

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**, 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.