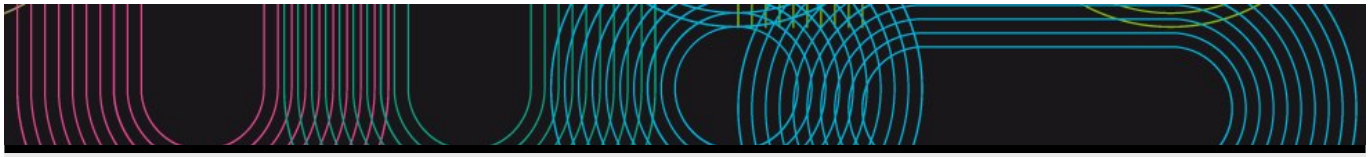

IDENTIFYING DATA				
Engineering of Electronic Equipment				
Subject	Engineering of Electronic Equipment			
Code	V05G300V01523			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge Sánchez Real, Francisco Javier			
E-mail	acevedo@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	This course shows students the basics concepts about RAMS (Reliability, Availability, Maintainability and Safety) of electronic components and electronic systems, as well as techniques to follow for a study of this type or design a system that meets specifications RAMS. the basics concepts about the sources of electromagnetic interference and their minimization are also discussed.			

Competencies	
Code	
B1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
B2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
B6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
B8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standarization in Telecommunications.
B9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
C41	(CE41/SE3):The ability to make the specification, implementation, documenting and tuning of electronic systems and equipment (both instrumentation and control oriented), considering the corresponding technical aspects and the regulations.
C47	(CE47/SE9): The ability to analyze and solve interference and electromagnetic compatibility problems .
D4	CT4 Encourage cooperative work, and skills like communication, organization, planning and acceptance of responsibility in a multilingual and multidisciplinary work environment, which promotes education for equality, peace and respect for fundamental rights.

Learning outcomes		
Expected results from this subject		Training and Learning Results
Knowledge of the applicable standards in the design of electronic systems	B2	C41
Ability for the specification of components and electronic systems		C41 C47
Knowledge and application of techniques to meet EMC standards		C47
Knowledge of techniques and tools for the design and manufacture of an electronic system based on dependability specifications	B2 B6 B8	

Ability to design, implement and manage a dependability system	B1	
Ability to manage the knowledge of the organization	B9	D4

Contents

Topic	
Item 1: Introduction	Definitions. Reliability Basics. RAMS Technologies. Statistical functions. Reliability Management.
Item 2: Reliability of electronic components	Definitions. Parameters (Failure rate, MTBF, MTTF). Reliability prediction of electronic components. Regulations.
Item 3: Reliability of electronic systems	Serie systems. Redundant systems. Reliability allocation. Redundancy optimitation. Srtandards.
Item 4: Maintainability and Availability	Definitions and types of maintenance. Parameters (Repair rate, MTTR). Stocks management. Availability of series and parallel systems. Regulations.
Item 5: Safety	Definitions. Electronic systems for safety applications. Safety level or safety category determination for safety electronic systems. Standards.
Item 6: Reliability tools	Failure mode effects analysis and criticalities (FMECA). Fault Tree (FTA). Markov Models. Standards.
Item 7: Essays	Types and test plans. Accelerated tests. Standards.
Item 8: Electromagnetic Interferences	Definitions. Fundamentals of electromagnetic interferences. Sources of interference. Minimization elements. Standards.
Item 9: Dependability management I	Improvement and quality insurance. Management of assets: ISO 55000.
Item 10: Dependability management II	Management by competencies. RRHH strategic management . Management of the knowledge.

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	6	12	18
Laboratory practises	8	0	8
Tutored works	0	60	60
Case studies / analysis of situations	7	0	7
Master Session	21	36	57

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

Methodologies

	Description
Troubleshooting and / or exercises	Teaching activities with problems develop, case studies and exercises related to the subject. Also it be used to show existing doubts and also for feedback to teachers. Competencies CG1, CG2, CG6, CE47 and CE41 are used
Laboratory practises	The students learn how to perform reliability calculations by using specific software for this application. Competencies CG2, CE41 and CT4 are used
Tutored works	Sspecific workbs that are related to the content of the subject and in partnership with a company or outside entity. Whenever possible, the student will develop two jobs one of them in collaboration with AENOR and another in collaboration with a company's environment. Competencies CG6, CG8, CG9, CE41, CE47 and CT4 are used
Case studies / analysis of situations	The groups are conducted with a small number of students and are used for the development of group work and learning methodologies teamwork. Competencies CG1, CG2 and CE41 are used
Master Session	It will develop in the schedules fixed by the direction of the engineering school. It consist of a presentation by the teacher, of the contents of the subject. Also proceed to solving examples and / or problems that illustrate the problems to be solved adequately. The student may submit all doubts and questions deemed appropriate, during the session. We will promote the more active participation of the student possible. Competencies CG1, CG2, CG6, CG8, CG9, CE41, CE42, CE47 and CT4 are used

Personalized attention

Methodologies	Description

Master Session	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject
Laboratory practises	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject
Tutored works	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject
Case studies / analysis of situations	The teacher will personally attend doubts and queries of students, on the study of theoretical, laboratory or projects. Students will have opportunity to attend individual tutorials or in groups in the teacher's office on schedule to be established for this purpose at the beginning of the course and to be published on the page of the subject

Assessment

	Description	Qualification	Training and Learning Results		
Troubleshooting and / or exercises	Deliverables, problems and exercises will be assess.	40	B1 B2 B6	C41 C47	
Tutored works	They will evaluate the contents (methodology of development, conclusions obtained, exhibition of results, capacity of work in team, capacity of work in multidisciplinary team) in the work in collaboration with the company. Also will take into account the opinion of the tutor in the company. The other work in collaboration with AENOR will value the quality of the work realised and the capacity of work in team.	60	B6 B8 B9	C41 C47	D4

Other comments on the Evaluation

The deliverables of the troubles and exercises are provide for guidance, for weeks 2, 4, 6, 8 and 10.
Following the guidelines for the degree and agreements of the academic committee, the students can choose between continuous assessment or the final exam on the date set by the engineering school.
Students who choose the continuous assessment should inform the instructor during the first two weeks of class.
Continuous assessment involves:

a) The students should do the problems and exercises and it will be delivered to the teacher. Maximun rating 4 ponits (40% of the final grade). The students must obtain a minimum of 2 points. These tasks are not recoverable later. Students do not exceed this minimum will have to do the final exam.

b) The students should do two jobs. One of them in collaboration with AENOR and students of the Faculty of Philology and Translation, and another in collaboration, with a company´s environment. Working in partnership with the company will be held in the months of February,March, April and May. Maximum rating 6 points (60% of the final grade).

The final exam assessment by the end of the semester or in the extraordinary (June-July), involves:

a) That the students perform and deliver on exam day, the exercises and problems posed in the subject, which is referred to in paragraph a) above. Maximum rating 4 points (40% of the final mark). The students must obtain a minimum of 2 points.

b)That the students the students to take an exam with questions and problems 2h corresponding to both the theoretical and laboratory. Maximum rating 6 points (60% of the final grade). The students must obtain a minimum of 3 points.

Students in the final examination do not exceed any of the two minimum requirements, the rating will be the lower of the average grade of the two scores and 4.5 points.

Sources of information

T.I. Bajenescu, M.I. Bâzu, **Reliability of Electronic Components**,

P. Kales, **Reliability**,

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

Kececioglu, Dimitri, **Reliability Engineering Handbook**,

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

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

ISO, **UNE-EN ISO 9000:2005: Sistemas de gestión de la calidad. Fundamentos y vocabulario.**,
ISO, **UNE-ISO 55000:2015: Gestión de activos. Aspectos generales, principios y terminología.**,

Recommendations

Subjects that are recommended to be taken simultaneously

Data Acquisition Systems/V05G300V01521

Subjects that it is recommended to have taken before

Mathematics: Calculus II/V05G300V01203
Digital Electronics/V05G300V01402
Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401