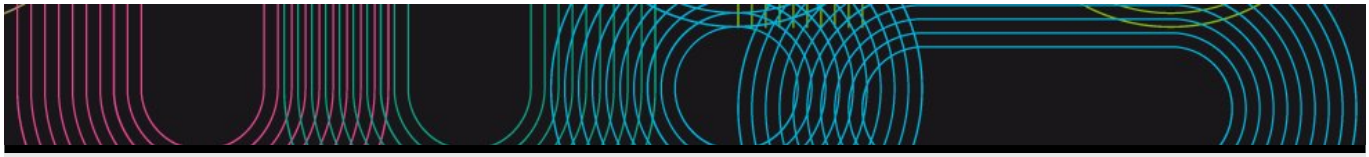

IDENTIFYING DATA				
Electronics and Photonics for Communications				
Subject	Electronics and Photonics for Communications			
Code	V05M145V01202			
Study programme	Máster Universitario en Ingeniería de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Barciela, Mónica			
Lecturers	Fernández Barciela, Mónica Fraile Peláez, Francisco Javier Isasi de Vicente, Fernando Guillermo			
E-mail	monica.barciela@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	The aim of the subject is that students acquire knowledge on the actual implementation of transceivers for the modern communication systems that transmit in the radiofrequency and optical bands bands. In the case of RF and MW transceivers, students will learn to evaluate performance, select and design components and analog circuits (active and passive) for them. As an learning aid, the student will use commercial circuit simulators. In the field of the optical communications, students will learn the operation of the basic transmission and reception components and active optoelectronical subsystems , and will be able to characterise them and select them as function of the optical system to be designed. In this course the student will handle technical and scientific bibliography in English language.			

Training and Learning Results	
Code	
B1	CG1 Ability to project, calculate and design products, processes and facilities in telecommunication engineering areas.
B4	CG4 Capacity for mathematical modeling, calculation and simulation in technological centers and engineering companies, particularly in research, development and innovation tasks in all areas related to Telecommunication Engineering and associated multidisciplinary fields.
C2	CE2 Ability to develop radio communication systems: antenna, equipment and subsystems design; channel modeling; link budgeting; and planning.
C3	CE3 Ability to implement systems by cable, line, satellite, in fixed and mobile communication environments.
C12	CE12 Ability to use programmable logic devices, as well as to design advanced electronic systems, both analog and digital. The ability to design communications components such as routers, switches, hubs, transmitters and receivers in different bands.
C13	CE13 Ability to apply advanced knowledge of photonics, optoelectronics and high-frequency electronics.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Learn to evaluate preformance, select and design components and analog subsystems (active and passive) for communication transceptors in diferent frequency bands (radiofrequency, microwaves). As learning aid, students will use circuit simulators.	B1 B4 C2 C3 C12 C13

Learn the operation of the components and basic transmission and reception active optoelectronical subsystems in optical communications and photonic processing, and being able to characterise them and select them as function of the optical system to design.	B1 B4 C2 C3 C13
Handle technical documentation and scientific bibliography in English	C13

Contents

Topic	
1. Introduction to analog circuit design for RF and Microwave transceivers for communications.	a. Communication systems transmitting at RF and microwave frequency bands. b. Semiconductor technologies and design techniques at the different frequency bands. c. Basic tools: S parameters and Impedance matching networks.
2. RF and Microwave passive circuits design.	Couplers, filters and resonators.
3. Design of Microwave linear amplifiers.	a. Design of bias and stabilization networks. b. Stability circles. Power gain circles. Noise circles. c. Amplifier design for maximum transducer gain. d. Low Noise amplifier design. e. Broadband amplifier design.
4. RF and Microwave power amplifier design.	a. Operating Classes. b. Load-line and power contours. b. Design for maximum output power. c. Linearity and energy efficiency.
5. Design of frequency converters.	Modular design of frequency converters.
6. Frequency Synthesizers	a. Synthesizers based on PLLs. b. Direct digital synthesis.
8. Photonics	a. Semiconductors optical properties. b. Fabry-Perot lasers and DFB. c. Photodetectors. Static and dynamic regime. d. Electro-optic and electro-absorbing modulators.

Planning

	Class hours	Hours outside the classroom	Total hours
Practices through ICT	8	20	28
Lecturing	29	58	87
Problem and/or exercise solving	1.5	2	3.5
Problem and/or exercise solving	0	2.5	2.5
Problem and/or exercise solving	1.5	2.5	4

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

Methodologies

	Description
Practices through ICT	This practices apply concepts related to the microwaves technologies part of the subject. They will be performed individually or in small teams of 2 students. With the aid of a commercial microwave and RF circuit simulator, students will analyze various passive (matching networks, filters, couplers, etc.) and active (amplifiers,..) circuits. It will be defined and evaluated different figures of merit and other parameters that will be used for circuits performance evaluation. In Moovi, students will have available support files and documentation. Through an agreement between UVIGO and the simulator provider, the student may apply for a temporary license of the simulator for his/her PC. The student work in these practice classes will be individually evaluated: 1. In continuous Evaluation: by test/s which include short questions/exercises or the design of some circuits, with the aid of the simulator, during or outside practices hours. 2. In Exam-only Evaluation: by means of short questions/exercises and circuit designs (with or without the aid of the simulator) related with the work performed during the practices in computer rooms. In these practices, students with work towards achieving competencies: CE2, CE3, CE12 y CE13

Lecturing	It will take place in a classroom with video projection facilities, blackboard and occasionally CAD tools. During these sessions it will be described in detail the relevant contents in the Subject program. The applications of some of theses concepts will be done thought exercises resolution, with or without CAD tools. In fact, some classes will be fully theoretical while others will include both theory and applications. Students will have available in Moovi support documentation and files. Competencies under work: CE2, CE3, CE12 y CE13

Personalized assistance

Methodologies	Description
Lecturing	During the master sessions the lecturer will answer the questions addressed by the students. Students will be also guided by the lecturer team during the time assigned for personalized attention in the office, in which their questions, related to the subject theoretical and practical work as well as the assessment tests and deliverables, will be solved. To apply for office hours: https://moovi.uvigo.gal/user/profile.php?id=11321
Practices through ICT	During the practices through ICT the lecturer will answer the questions addressed by the students and guide their assigned work. To apply for office hours: https://moovi.uvigo.gal/user/profile.php?id=11321

Assessment

	Description	Qualification	Training and Learning Results
Practices through ICT	The student work in these practices, related to microwave technologies, will be individually evaluated: 1. In Continuous Assessment: through one/several short examinations with questions/exercises and/or performing simple designs, with the aid of the simulator, during or out of the practices schedule. One of these tests may imply a deliverable involving the design of a circuit. 2. In Exam-only Assessment: by means of short questions/exercises and circuit designs (with or without the aid of the simulator) related with the work performed during the practices.	30	C2 C3 C12
Problem and/or exercise solving	In Continuous Assessment: - There will be 1 Short Examination with exercise solving (may also include short questions), related to the microwave technologies part. In Exam-only Assessment: -The Final Exam will also include exercises resolution, with or without the aid of the simulator, and may include short questions.	20	C2 C3 C12
Problem and/or exercise solving	With respect to the part of the subject related to RF technologies: In Continuous Assessment, students will solve, in individual form or in reduced groups, the proposed exercises/designs, with the help of CAD tools. They will deliver a written report that will be evaluated. The evaluation could be complemented by means of an interview about the performed work. In Exam-only Assessment, the examination will include similar exercise solving, to solve individually.	25	C2 C3 C12
Problem and/or exercise solving	In Continuous Assessment: - There will be 1 Short Examination with exercise solving (may also include short questions), related to Photonics. In Exam-only Assessment: -The Final Exam will also include exercises resolution, with or without the aid of the simulator, and may include short questions.	25	C2 C3 C12 C13

Other comments on the Evaluation

It is convenient that students attend all CAD practices, since through them the lecturer will guide the student home work related to these practices. It is also convenient for the student to perform all the proposed practices and exercises, in order to achieve the skills required to pass the Subject assessment tools.

First Call:

A) In the case that the student opts for *Continuous Assessment*:

1. It is mandatory to attend at least 80% of the CAD practices, related to microwave technologies. In this case, the evaluation of these practices will be done through one/several individual Examinations with the support of CAD tools. One of these tests may be replaced by a deliverable report about a proposed circuit design. The total grade achieved in these assessment test corresponds up to 30% of the Subject Qualification (SQ).
2. The evaluation of the subject part related to RF circuit design, will be done through one or several deliverable reports (performed individually or in group) about some proposed designs or exercises, with the aid of CAD tools. This evaluation may include an interview about the work. The total grade achieved will be up to 25% of the SQ.
3. The rest of the assessment with be individually performed through 2 Short Examinations, that may contain exercise resolution and/or short questions:- Exam 1 related to the microwave technologies content, 20 % SQ.- Exam 2 related to Photonics, 25% SQ. On week before Exam 2 takes place, students must communicate the subject coordinator their chosen option for the Subject Assessment: Continuous Assessment or *Ex*am-only Assessment.
The schedule of the midterm/intermediate exams will be approved by the Comisión Académica de Grado (CAG) and will be available at the beginning of each academic semester. These intermediate exams do not have "second-chance" examinations.
B) If the student opts for *Exam-only Assessment (100% SQ)*, this exam will involve all the subject content (theory and practices) and include: exercises resolutions and/or designs (with or without the aid of the circuit simulator) and/or short questions.
Second Call and *End-of-program call*:
Students who failed the First Call will perform a similar exam as the one in option B. In particular, students that in the First Call chose continuous assessment and want to preserve his/her qualifications obtained in the microwave CAD practices (30 % SQ) and the RF technology deliverables (25% SQ), must perform a shorted version of the exam in option B (with a total weight of up to 45% SQ), involving most of the subject content, but excluding the RF part and the simulator aid.
On week before Exam takes place, students must communicate the subject coordinator their chosen option for the Subject Assessment: Continuous Assessment or Exam-only Assessment.
In case of plagiarism detection in any of the proposed works/assessment tools performed by the student, his final Subject qualification will be a failure rate of (0), and the coordinator will communicate the school Board this issue so appropriate measures may be taken.

Sources of information

Basic Bibliography

D.M. Pozar, **Microwave Engineering**, 3,
Guillermo González, **Microwave Transistor Amplifiers: Analysis and Design**, 2,
Bahaa E. A. Saleh, Malvin Carl Teich, **Fundamentals of Photonics**, 2,
Guillermo González, **Foundations of Oscillator Circuit Design**, 1,
Rhea, Randall W., **HF filter desing and computer simulation**, 1,
John L. B. Walker, **Handbook of RF and Microwave Power Amplifiers**, 1,

Complementary Bibliography

Enrique Sánchez, **Introducción a los dispositivos y circuitos semiconductores de microondas**, 1,
Steve C. Cripps, **RF Power Amplifiers for Wireless Communications**, 1,
Steve C. Cripps, **Advanced Techniques in RF Power Amplifier Design**, 1,
Amnon Yariv, Pochi Yeh, **Photonics Optical Electronics in Modern Communications**, 6,
S. O. Kasap, **Optoelectronics and Photonics: Principles and Practice**, 2,
Egan, William F., **Phase-lock basics**, 1,
Rhea, Randall W., **Discrete oscillator design : linear, nonlinear, transient, and noise domains**, 1,

Recommendations

Subjects that continue the syllabus

Microwave and Millimetre Wave Circuit Design and CAD/V05M145V01317