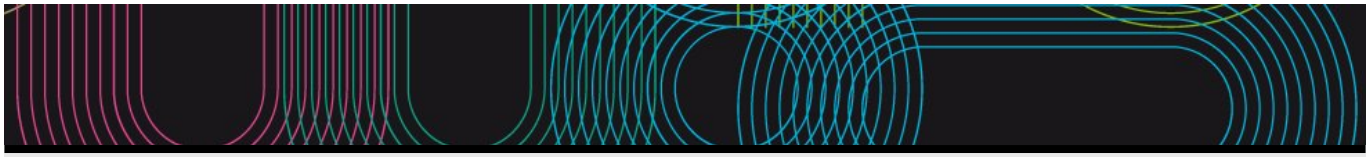

IDENTIFYING DATA				
Microwave Circuits				
Subject	Microwave Circuits			
Code	V05G300V01611			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish English			
Department				
Coordinator	Fernández Barciela, Mónica			
Lecturers	Fernández Barciela, Mónica Rodríguez Rodríguez, José Luis			
E-mail	monica.barciela@uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject provides the student with the basic tools to analyze components and analog subsystems (active and passive) that operate in the band of the microwaves, as well as to evaluate his specifications and performance. The microwave subsystems are part, among others, of the modern communications systems transceivers (cellular telephony, wireless networks, satellite communications, and so on), thus the importance for the student to get some knowledge and background about these components. On the other hand, this subject complements the knowledge the student has, due to previous subjects, in electronics for communications, since when working in the microwave range, we need to use different tools for an accurate circuit analysis and design.			

Competencies	
Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A9	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.
A32	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
A33	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
A34	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.

Learning aims	
Expected results from this subject	Training and Learning Results
To learn how to analyze microwave active and passive circuits and components, and to evaluate their specifications and performance. The student will learn how to use S-parameters, electronic instrumentation for measurements in the microwave range and circuit simulators for that purpose.	A3 A4 A5 A32

To learn how to solve exercises, how to perform measurements, how to elaborate and present reports, how to work in a technical team and to transfer knowledge in the field. To learn how to handle technical documentation and scientific bibliography, both in English.	A5 A9 A33 A34
To learn how to select, analyze and apply semiconductor active devices in circuits for microwave communications subsystems.	A3 A4 A32 A33 A34
To learn how to analyze and select microwave circuits for optical transmitters and receivers.	A3 A4 A32 A34
To learn how to evaluate and select microwave subsystems. To propose solutions for applications at the different frequency bands for guided (coaxial cable, waveguide) and wireless transmissions.	A4 A5 A33 A34

Contents

Topic	
1.Introduction to microwave circuits.	A. Technologies for high frequency bands. B. Applications. C. Microwave Subsystems. Solutions for applications in the different frequency bands for wave guided and wireless transmissions.
2. Basic concepts.	A. Transmission Lines Theory. Travelling waves, characteristic impedance and reflection coefficient. Smith Chart. B. Coaxial cable and planar transmission lines.
3. S-parameters.	A. Definition and properties. B. Flow charts. C. Power and Gain. D. Stability.
4. Impedance Matching.	Basic matching networks (discreet and distributed).
5. Microwave passive components.	Filters, couplers, phase shifters and resonators.
6. Microwave active devices for integrated circuits.	A. Semiconductors for microwave integrated circuits. B. Diodes c. Transistors
7. Circuits for microwave transceivers.	A. Linear microwave amplifiers. B. Circuits for optical receivers and transmitters.
8. Analysis of microwave active and passive components, and circuits with a commercial simulator.	
9. Measurements on microwave devices and circuits.	Microwave measurement systems for linear device characterization.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practises	4	6	10
Practice in computer rooms	8	12	20
Tutored works	6	12	18
Master Session	19	38	57
Troubleshooting and / or exercises	4	32	36
Reports / memories of practice	1	8	9

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

Methodologies

	Description

Laboratory practises	With the aid of different microwave measurement instruments/ components, there will be analyzed passive and active microwave devices / circuits in microstrip technology. It will be defined and evaluated different figures of merit and other tools that will be used in the experimental characterization of these components. An introduction to Vector Network Analyzers with be provided to the student. Their use and calibration procedure will be described. The student work during these laboratory practises will be evaluated: 1. In continuous assessment: by means of a set of short questions to be delivered in writing at the end of some of the practises, and in all or some of the three short examinations involving exercises resolution. 2. In the evaluation in only a final examination: by means of a set of questions related to the work performed in the experimental practices. These practises are designed to help in adquiring competencies A5, A32, A33 and A34.
Practice in computer rooms	With the aid of a commercial microwave circuits simulator, there will be analyzed different passive components (matching networks, filters, couplers, etc.) and active semiconductor devices (diodes and transistors), and simple amplifier circuits, in agreement with Chapter 8. There will be defined and evaluated diverse figures of merit and other tools that will be in used in the analysis of these components. The evaluation of the student work in these computed aided practises will be performed: 1. In continuous assessment: by means of short questions to be delivered in writing, at the end of some of the practices, and in all or some of the three short examinations involving exercises resolution. 2. In the evaluation in only a final examination: by means of questions related to the work performed during these practices. These practises are designed to help in adquiring competencies A4, A32, A33 and A34.
Tutored works	The student, as part of a team, will study and develop a theoretical topic or a certain practical design, which later will be evaluated by means of a writing report and an oral presentation. These works are designed to help in adquiring competencies A3, A32, A33.
Master Session	It will be given in a classroom with the aid of a slate board and a video projector. Most of the concepts in the Chapters will be described in detail and explained. There will be also described several exercises resolutions. These sessions are designed to help in adquiring competencies A3, A32, A33.

Personalized attention

Methodologies	Description
Laboratory practises	During the scheduled experimental and computer practices and team work meetings, the lecturer will guide the student work and solve doubts that may arise as a consequence of the designated tasks. The student will have available additional time for tutorship, in which to solve his/her doubts and questions.
Practice in computer rooms	During the scheduled experimental and computer practices and team work meetings, the lecturer will guide the student work and solve doubts that may arise as a consequence of the designated tasks. The student will have available additional time for tutorship, in which to solve his/her doubts and questions.
Tutored works	During the scheduled experimental and computer practices and team work meetings, the lecturer will guide the student work and solve doubts that may arise as a consequence of the designated tasks. The student will have available additional time for tutorship, in which to solve his/her doubts and questions.

Assessment

	Description	Qualification
Laboratory practises	In the case of continuous assessment, during the designated time for experimental practices the student will answer in writing to some proposed questions. Besides, in any of the three short examinations, the work performed in the available time for practices may be evaluated. In the case a unique evaluation in a final examination, the work performed in the available time for practices may be evaluated. Competencies evaluated are A5, A32, A33 and A34.	10
Practice in computer rooms	In the case of continuous assessment, during the designated time for practices the student will answer in writing to some proposed questions. Besides, in any of the three short examinations, the work performed in the available time for practices may be evaluated. In the case a unique evaluation in a final examination, the work performed in the available time for practices may be evaluated. Competencies evaluated are A4, A32, A33 and A34.	10

Troubleshooting and / or exercises	There will be three short examinations, each will contain exercises resolution. Moreover, they may contain a set of short questions related to the magisterial classes or the practices, both experimental or computer aided. Competencies evaluated are A3, A4, A32, A33 and A34.	70
Reports / memories of practice	It will be evaluated both the written report and the oral presentation of the team work performed. Competencies evaluated are A4, A5, A9, A32 and A34.	10

Other comments on the Evaluation

A) If the student selects continuous assessment:

1. His/her presence in all scheduled experimental and computer aided practices will be mandatory, as well as his/her presence in all scheduled team meetings. In order that his/her work as part of the team is evaluated, the corresponding written report and oral presentation will be mandatory, personally or as part of the team (to be decided by the lecturer). The maximum mark the student might obtain in the evaluation of all the scheduled practices and team work is 30 % of the total available mark for the subject.

2. The rest of the work in the subject will be evaluated by mean of three short examinations that will contain mainly exercises resolution, but that also may contain short questions. These three short examinations as a whole add up to 70 % of the total subject qualification.

The first short examination will take place around the 6th week, and the second around the 10 th week, term period. Both examinations may last 1 hour, and each corresponds to 15% of the total mark in the subject. Before the second short examination, the student must make know to the lecturer his decision about the type of evaluation he prefers: continuous assessment, or being evaluated only in a final examination. The third short examination will take place with the final examination performed for those students who do not follow continuous assessment. This short examination is also mandatory for those students following continuous assessment and it corresponds to a 40 % of the total subject qualification. To pass the subject, the student must obtain in this third short exam a mark equal or higher to the 30% of the total exam qualification. Otherwise, the marks he obtained in the computer and lab practises, and team C work will not be considered (added) to compute his/her final subject qualification.

B) In the case of the students who does not choose continuous assessment, the final (long version) and only examination corresponds to 100% of the subject qualification. In this examination it will be evaluated exercises resolution (in their extended version), answers to short questions related to the subject theoretical part, and the experimental and computer/simulator aided practices.

The second summons (July):

In July the students who have previously failed will have to perform a similar final examination than in option B, with similar characteristics as the ones described previously. In particular, the students who followed continuous assesment and want to preserve the qualifications obtained in the practices (both experimental and computer aided) and in the team work (that will add as a whole up to 30 % of the total subject qualification) will solve a reduced version of the final examination described in previous paragraph (which will corresponds in this case to 70 % of the total qualification).

Sources of information

R.E. Collin, **Foundations for Microwave Engineering**, 2,

D.M. Pozar, **Microwave Engineering**, 3,

P.A. Rizzi, **Microwave Engineering, Passive Circuits**, 1,

S. Y. Liao, **Microwave Devices and Circuits**, 3,

J.M. Miranda y otros, **Ingeniería de Microondas**, 1,

Guillermo González, **Microwave Transistor Amplifiers: Analysis and Design**, 1,

Enrique Sánchez, **Introducción a los dispositivos y circuitos semiconductores de microondas**, 1,

Notes / viewfolds of the content of the magisterial classes.

Guides of the experimental and computer aided practices.

Recommended books.

Internet.

Recommendations

Subjects that are recommended to be taken simultaneously

Radio Frequency Circuits/V05G300V01511

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201
Physics: Fields and Waves/V05G300V01202
Physics: Fundamentals of Electronics/V05G300V01305
Electronic Technology/V05G300V01401
Electromagnetic Transmission/V05G300V01303