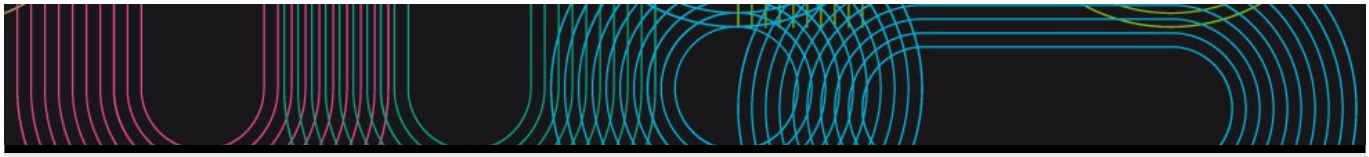

IDENTIFYING DATA				
Microwave Circuits				
Subject	Microwave Circuits			
Code	V05G300V01611			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Barciela, Mónica			
Lecturers	Fernández Barciela, Mónica Rodríguez Rodríguez, José Luis			
E-mail	monica.barciela@uvigo.es			
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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	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	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.
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
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.
C23	CE23/ST3 The ability to analyze the components and their specifications for guided and non-guided communications systems
C24	CE24/ST4 The ability to select circuits, subsystems and systems of radiofrequency, microwaves, broadcasting, radio link and radio determination.
C25	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.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.
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

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.	B3 B5	C23	
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.	B4 B5 B9	C24 C25	D3 D4
To learn how to select, analyze and apply semiconductor active devices in circuits for microwave communications subsystems.	B5	C23 C24 C25	
To learn how to analyze and select microwave circuits for optical transmitters and receivers.	B5	C23 C25	
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.	B3 B5	C24 C25	D2

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 during 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 CG3,CG5, CE23, CE24, CE25, CT2 y CT3.
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. Also, exercise resolution will be described. 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, during 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: CG3, CG5, CE23, CE24 y CE25.
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 CG4, CG9, CE23, CE24 , CE25, CT2, CT3 y CT4.
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 exercises resolution. These sessions are designed to help in adquiring competencies CG3, CG5, CG4, CE23, CE24 y CE25.

Personalized attention

Methodologies	Description
Master Session	While in master sessions, the professor will answer the questions addressed by the students. Besides, in office hours, the professor will also be available to the students, providing answers to their questions a more personalized way.
Laboratory practises	During laboratory practises, the professor will guide the work of each student, and answer those questions he/she may ask.
Practice in computer rooms	During practises, the professor will guide the work of each student, and answer those questions he/she may ask.
Tutored works	In tutored works, the professor will guide the work of each student/group, and answer those questions that may arise individually or as a group.

Assessment

	Description	Qualification	Training and Learning Results
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.	7	B3 C23 D2 B5 C24 D3 C25
Practice in computer rooms	In the case of continuous assessment, during the designated time for practices the student will answer/solve in writing to some proposed questions/exercises. 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 during practices may be evaluated.	5	B3 C23 B5 C24 C25
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 master sessions or the practices, both experimental or computer aided.	80	B3 C23 B4 C24 B5 C25

Reports / memories of practice	It will be evaluated both the written report (team work) and the team oral presentation of this work. During the oral presentation, the professor will ask questions to each member of the team and will grade his feedback, individually. The grade of this work for each student will be the sum of the written report grade (team grade) plus the grade of his/her oral presentation.	8	B4 C23 D2 B9 C24 D3 C25 D4

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/herwork as part of the team is evaluated, the corresponding written report and oralpresentation will be mandatory. The maximum grade the student might obtain in theevaluation of all the scheduled practices and team work is 20 % of the totalavailable grade for the course.

2. The rest of the student work will be evaluated by means of three shortexaminations that will contain mainly exercises resolution, but that may also contain short questions. These three short examinations, as a whole, add up to 80% of the total course grade.

The First short Examination will take place around the 6th week, and the Second one around the 10th week, term period. Both examinations may last1 hour, and each corresponds to 10% of the total course grade. Before the Second short Examination, the student must send a written communication to the lecturer with his/her decision about the type of evaluation he/she prefers: continuous assessment, or being evaluated only in a Final Examination.

The Third short Examination will take place simultaneously with the Final Examination, performed for those students who do not follow continuous assessment. This short examination is the most important one, and it corresponds to a 60 % of the total subject qualification.

B) In the case of the students who does not choose continuous assessment, the one Final (extended) Examination corresponds to 100% of the course grade. In this examination it will be evaluated exercises resolution, answers to short questions related to the course theoretical part and experimental and computer/simulator aided practices.

The second summons (July):

In July the students who have previously failed must perform a similar Final Examination than in option B, with similar characteristics as the ones described previously.

In particular, those students who followed continuous assesment in the first summons may opt now between option B and option A.

If they choose opt. A, all their grades in the first summons, with respect to the First and Second Examinations, the practices (both experimental and computer aided) and the teamwork will be preserved; hence, it will add up as a whole to 40 % of the total course grade. Besides, these students must solve an examinations similar to the Third one in opt. A (corresponding to 60 % of the total course grade). Before the Final Examination, the student will send a written communication to the course coordinator about his/her decision with respect to the desired type of evaluation (A or B).

In case of plagiarism detection in any of the student works/tests, the grade obtained by the student in this course will be a failing grade (0) and the course professor will communicate this issue to the school Board of Directors so they may take those measures deemed appropriate.

Sources of information

Basic Bibliography

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

Complementary Bibliography

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

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

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

Recommendations

Subjects that are recommended to be taken simultaneously

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