Universitat Autònoma de Barcelona

2020/2021

Microwave Engineering

Code: 102703
ECTS Credits: 6

Degree	Type	Year	Semester
2500898 Telecommunication Systems Engineering	OT	4	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: Yes

Prerequisites

There is not precondition

Objectives and Contextualisation

In wireless communication systems the channel is an asset shared by different users and / or by different communication services. In this sense, communications systems use the electromagnetic spectrum in high frequency.

The subject of Microwave Engineering is focused on the design of specific components for the RF and Microwave communication equipment. Objectively, it deals with providing the knowledge to understand theoretical phenomena, and practical experiences, of application in the development of hardware and simulation software in industrial projects with needs of both the space segment (telecommunication, navigation, earth observation and space sciences), as well as wireless terrestrial communications systems, whether wireless fixed as mobile.

Microwave engineering provides key tools to face technological challenges such as the design of radio frequency components and subsystems, for both terminal equipment and radio communications base stations. Requirements and technologies, factors for miniaturization.

The more detailed objectives are presented in the following list, so we consider that the student at the end of the course will be able to:

- Use tools for analysis and synthesis of devices and subsystems in the radio frequency and microwave bands, as well as to introduce the most widely used technologies in high frequency.
- Manage the formulation of scattering parameters as a tool for synthesis and analysis of devices in high frequency. As well as the fundamental properties.
- Analyze and design passive devices of n-ports, by means of the techniques provided, present in a RF-FEM (Radio Frequency-Front End Module): attenuators, dividers, couplers, resonators, modulators.
- Design linear and nonlinear devices based on active elements (switch, limiters, mixers, amplifiers)
- Express the conclusions of the work in the appropriate technical language.

Competences

- Communication
- Develop personal attitude.
- Develop thinking habits.
- Draft, develop and sign projects in the field of telecommunications engineering that, depending on the speciality, are aimed at the conception, development or exploitation of telecommunication and electronic networks, services and applications.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Select and devise communication circuits, subsystems and systems that are guided or non-guided by electromagnetic, radiofrequency or optical means to fulfil certain specifications.

Learning Outcomes

1. Analyse and design radiofrequency, microwave, broadcasting, radio-link and radio-determination antennas, circuits, subsystems and systems.
2. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
3. Design radio communication based applications, understood to be systems for receiving and transporting information.
4. Develop curiosity and creativity.
5. Develop systemic thinking.
6. Develop the capacity for analysis and synthesis.
7. Generate innovative and competitive proposals in professional activity.
8. Manage information by critically incorporating the innovations of ones professional field, and analysing future trends.
9. Use specific simulation tools to analyse and design radiofrequency telecommunication applications.

Content

1. TRANSMISSION LINE.

2. GEOMETRIES OF THE TRANSMISSION LINE.

Planar transmission line, STRIPLINE.

Planar transmission line, MICROSTRIP.

3. MATRIX REPRESENTATION MICROWAVE CIRCUITS.

Scattering parameters.

Relationship between parameters s, z and y.

Properties of the scattering matrix.

Parameters [s] in networks with symmetry plane.

Power transfer gain. Voltage gain and scattering parameters.

Two ports passive networks.

Lossless passive networks.

Scattering parameter of transmission line.

4. PASSIVE MICROWAVE CIRCUITS.

Attenuators

Three ports passive networks (i).

Circulator

Resistive dividers.

Dividers using transmission lines

Wilkinson's divider.

Four-port networks (directional coupler).

Hybrid of 90º.

Hybrid of 180º.

General applications

Operation as phase detector.

Four ports networks with coupled lines.

Analysis with edge coupling.

Microwave resonators

Methodology

The following training activities will be developed:

• Theory lessons where the main concepts of the subject will be explained, including examples and Applications.

• Practical problem classes where the emphasis will be placed on procedural aspects in the resolution of questions.

• Laboratory classes where the practical experimentation of the concepts developed in theoretical class.

The lessons of theory and problem solving will take place simultaneously on the blackboard and with slides.

Students will be provided with a collection of problems prior to their resolution in the class.

The professor will receive the students in his office during the specified tutoring hours, in order to solve doubts, develop concepts, etc.

It is highly recommended to attend these tutorials for better use of the course.

It will be ensured that all the material is available to students through the Campus Virtual.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem seminars	15	0.6	6
Session Labs	10	0.4	9

Theoretical classes	30	1.2	1, 6, 3
Type: Supervised			
Lab tutorship	5	0.2	
Microwave Engineering Tutorship	13	0.52	4
Type: Autonomous			
Individual study	30	1.2	5, 3
Lab Practicum review	10	0.4	2, 9
Problem solving and case study	15	0.6	6

Assessment

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Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
EXAM 1	30 %	1.5	0.06	1, 5, 6, 3
EXAM 2	30%	1.5	0.06	1, 2, 5, 6, 3
Lab Practicum	30%	15	0.6	1, 4, 8, 9
Lab exam	10%	1	0.04	1, 7, 9
REEVALUATION EXAM	60 %	3	0.12	5, 6, 3

Bibliography

Basic References

Microwave Engineering

D.M. Pozar, Adison Wesley, 1990.3ra edición, ISBN:0-471-44878-8

Consulting Referenes

Circuits de Microones amb Línies de Transmissió

J. Bará, Edicions UPC, 1993.

Microstrip Filtres for RF/Microwave Applications

Jia-Sheng HONG, M. J. Lancaster, John wiley & sons, ISBN 0-471-22161-9

RF and Microwave Coupled-Line Circuits

R. K. Mongia, I. J. Bahl, P. Bhartia, J. Hong, Artech House, 2007, Second Edition, ISBN: 978-1-59693-156-5

Microwave Solid State Circuit Design

I. Bahl, P. Bhartia, John Wiley, 1988