SUBJECT TEACHING GUIDE

G1487 - Microwaves

Degree in Telecommunication Technologies Engineering

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Degree in Telecommunication Technologies Engineering			Type and Year	Optional. Year 4
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Speciality Optional Subjects				
Course unit title and code	G1487 - Microwaves				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIA DE COMUNICACIONES
Name of lecturer	EDUARDO ARTAL LATORRE
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Other lecturers	AMPARO HERRERA GUARDADO BEATRIZ AJA ABELAN

3.1 LEARNING OUTCOMES
- Analysis and design of microwave circuits based on transmission lines and waveguides. Use of technical data sheets of microwave components extracting the useful information. Characterization of microwave systems at circuit and subsystem levels, using matricial parameters based on voltages and currents or in waves. Solution of application practical problems with passive and active microwave components.
- Ability to analyze and design microwave active and passive circuits and subsystems, as basic components in a radio communication system.

4. OBJECTIVES

Analysis and design of microwave active and passive circuits and subsystems. Application of active devices (semiconductors) in microwave circuits addressed to radio communication systems.

6. COURSE ORGANIZATION

CONTENTS	
1	Chapter 1: Introduction: Microwave bands. Dimensions and delays. Limitations of conventional components. History of Microwaves. Transmission lines and waveguides. Microstrip line.
2	Chapter 2: Microwave circuits with transmission lines: Two port and multiport networks. Matrix Z and matrix Y. Matrix S: meaning and properties. Passive, reciprocal and lossless networks. Two port networks: ABCD and T matrix. Y matrix of a transmission line. Implementation of N-port networks with quarter wave and half wave length lines. Input and output impedances. Power transfer gain. Resistive attenuators. Matching networks. Equivalent circuits of a transmission line. N-port networks, properties. Fully matched network. Power dividers, Wilkinson divider. Circulators. Four port networks. Directional coupler. Hybrids: 3dB/90 degrees and 3 dB/180 degrees, applications, implementation with transmission lines. Directional couplers: with quarter wavelength lines, with coupled lines. Impedance inverter: Z, Y and S matrix. Microwave filters: low pass and band pass.
3	Chapter 3: Waveguide microwave circuits: rectangular waveguide: waves and modes. The TE10 mode. Equivalent voltages and currents in waveguides. N-port waveguide networks. Diaphragms and reactive elements in rectangular waveguides. Tees in rectangular waveguides. E-plane and H-plane Tee. Magic Tee, applications. Waveguide directional coupler. Transition from coaxial to waveguide.
4	Chapter 4: Microwave circuits with semiconductors: single stage transistor amplifier. S-parameter design. Amplifier stability and noise figure. Unilateral design, gain circles. Bilateral design. Oscillators: design based on negative resistance devices. Example: IMPATT oscillator. Device and load lines. Oscillator based on transistors. MMIC circuits. Diode detectors and mixers.
5	Chapter 5: Microwave communication systems: guided and radiated systems. Friis transmission equation. System examples: TV satellite receiver for ASTRA satellite, receiver for a MMDS system of TV distribution.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Two written tests along the four-month period, based on questions, each one with several answers and only one of them valid.	Written exam	No	No	15,00
Practical exercises to be solved individually at home.	Others	No	No	15,00
Design and simulation of microwave circuits. Measurements with microwave equipment in the laboratory. To write an individual report of designs and test results.	Laboratory evaluation	No	No	20,00
Final written exam with practical problems to be solved plus a test based on questions and answers.	Written exam	Yes	Yes	50,00
TOTAL				100,00

Observations

The attendance to laboratory works is compulsary. The final score is computed according to the expression:
Final score = max [(15 CP + 15 EC + 20 PL + 50 EF)/100, (15 CP + 20 PL + 50 EF)/85, (15 EC + 20 PL + 50 EF)/85, (20 PL + 50 EF)/70] where
CP = Control tests
EC = Individual exercises
PL = Laboratory works
EF = Final exam

Minimum (0), maximum (10)

Observations for part-time students

The assessment method for partial time students is the same method explained above.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

[1] David Pozar, "Microwave Engineering", Third Edition, John Wiley, 2005.
[2] R.E. Collin, "Foundations for microwave engineering", 2nd edition, Mc Graw Hill, 1992.
[3] Javier Bará, "Circuitos de microondas con líneas de transmisión", Edicions UPC, 1ª edición, 1994.
[4] S. Ramo, J.R. Whinnery, T.V. Duzer, "Fields and waves in communication electronics". John Wiley, (Third edition) 1993.