VNIVERSITAT DE VALÈNCIA

Course Guide
43859 Design of advanced communications components

COURSE DATA

Data Subject	
Code	43859
Name	Design of advanced communications components
Cycle	Master's degree
ECTS Credits	4.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2174 - M.U. en Ingeniería de Telecomunicación 13-V.2	School of Engineering	1	First term

Subject-matter

Degree	Subject-matter	Character
2174 - M.U. en Ingeniería de Telecomunicación 13-V.2	13 - Design of advanced communications components	Obligatory

Coordination

Name	Department
EJEA MARTI, JUAN BAUTISTA	242 - Electronic Engineering
REAL MAÑEZ, DIEGO	242 - Electronic Engineering

SUMMARY

Architecture and Design of Advanced Communications Components (ADAC) is taught in the second semester of the first year of the Master in Telecommunication Engineering.

The purpose of this course is to develop skills that enable the student to identify, describe and design systems for different RF bands used in communications systems. Also the student will be able to stabilize different types of amplifiers and use different types of RF ICs on the market. The student will also learn the different parts of a communication system, be competent in its specification (selection) and its generic design.

In turn, the student will be able to identify, describe and design optical communication systems and their major components. It will also be able to specify different types of subsystems that link optical communication systems with electronic communication systems and the physical principles underlying.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Los conocimientos previos necesarios para seguir el curso de la asignatura son los que se adquieren en las materias del grado de Ingeniería Industrial, el grado de Ingeniería Electrónica en Telecomunicación y el grado de Ingeniería Telemática.

OUTCOMES

2174 - M.U. en Ingeniería de Telecomunicación 13-V.2

- To have critical thinking capabilities to investigate independently and self-critically, and to search and utilize information for documenting ideas.
- To have the capability to identify and solve the critical points to conduct an effective technology transfer, transforming theoretical results into products and services that are useful for the society.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Be able to access to information tools in other areas of knowledge and use them properly.
- To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.
- Ability to apply advanced photonics and optoelectronics knowledge, as well as high-frequency electronics concepts.
- Ability to design communications components such as routers, switches, hubs, emitters and receptors in several bands.

LEARNING OUTCOMES

Identify and describe the major blocks of a RF system along with its key design parameters.
- Amplifiers
- Oscillators and mixers
- PLL

In turn, the student will be able to identify, describe and design optical communication systems and their major components. It will also be able to specify different types of subsystems that link optical communication systems with electronic communication systems and the physical principles underlying.

DESCRIPTION OF CONTENTS

1. Introduction to communicaction electronics

Review of Modulation concepts: baseband and modulated signal.
Block diagram of RF system
Basic design parameters of RF systems
RF system types

2. Radiofrequency amplifiers

Parameters of RF amplifiers: linear and nonlinear
Analysis of gain and power transfer in tuned RF amplifiers
Stability Analysis of tuned amplifiers: Linvill criteria and Stern
Noise in active elements
Design procedure of a tuned RF amplifier
Design Example

3. Oscillators and mixers

Functional description of an oscillator
Oscillation conditions
Characteristic parameters
Description of noise in an oscillator: phase noise and Leeson model
Description of types of oscillators
Quartz Crystal Oscillators
Voltage controlled oscillator
Mixers Operating principle
Mixers specifications
The problem of the image band
Examples of circuits and catalog datasheets

4. PLL and syntethizers

Description of PLL
Obtaining the transfer function
PLL specifications
Description of the PLL operation with different types of filters
Phase Detectors: types and characteristics
Frequency Synthesis: Basic operation
Frequency Synthesizers Types

5. Materials for photonic components: structural properties

States of the matter: order
Crystalline materials
Interfaces
Polycrystalline materials
Amorphous materials
Liquid crystals
Defects found in crystals
New techniques and new materials

6. Light propagation in media

Maxwell equations and wave equation
Polarisation of light
Propagation: Fresnel formulae
Wave propagation in crystals
Light modulation by means of polarisation

7. Optical fibers

Physical properties of waveguides
Planar waveguides: a geometrical optics study
Optical fibres: analysis base don geometrical optics
Limitations on polarisation in waveguides
Guided modes in planar waveguides: applying wave theory
Guided modes in optical fibres: applying wave theory
Propagation of wave packet: dispersion and group velocity
Light sources and detectors for optical fibres

8. Optical couplers and modulators

Light coupling devices: guide to guide couplers
Coupled mode theory and directional couplers
Light to waveguide coupling
The need of high speed light modulation
Electro-optical modulators
Interferometric modulators
The directional coupler
Advanced devise for light modulation and switching

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	27,00	100
Tutorials	9,00	100
Laboratory practices	4,00	100
Development of individual work	10,00	0
Study and independent work	10,00	0
Readings supplementary material	5,00	0
Preparing lectures	25,00	0
Preparation of practical classes and problem	10,00	0
TOTAL	**100,00**	

TEACHING METHODOLOGY

Teaching methods to be used in the development of the subject are as follows:

(MD1) Theoretical activities. Exhibition development of matter with student participation in resolving specific questions. Realization of individual evaluation questionnaires.

(MD2) Practical activities.

Learning by solving problems, exercises and case studies to facilitate the acquisition of competences on different aspects of the subject.

These teaching methods are developed in the following training activities:

(AF1) Theoretical activities.

In the theoretical classes the topics will be developed providing a global and inclusive vision, analyzing in more detail the key and more complex aspects, encouraging student participation at all times.

(AF2) Practical activities.

These activities complement the theoretical activities with the aim of applying and expanding the basic concepts with the knowledge and experience that students acquire during the performance of the proposed work. They include the following types of classroom activities:

• Classes of problems and questions in the classroom.

• Discussion sessions of problem and exercises previously prepared by students.

• Making group projects.

• Laboratory sessions.

(AF3) Personal work of the student.

Performing of questions and problems outside the classroom, as well as preparation of classes and exams (study). This task tries to promote individual work and will be done individually.

(AF5) Tutoring. The objective of the tutorials will be to guide and solve any doubt that appears. To do this, students should propose them, thus allowing the teacher to review its work process.

Platforms of e-learning (virtual classroom) to support communication with students will be used. Through it the student will have access to didactic materials used in class as well as problems and exercises to be solved.

EVALUATION

Learning outcomes are evaluated by the following criteria:

(SE1) Objective test consisting of one or more tests with problems and theoretical-practical questions.

(SE2) Evaluation of practical activities consisting of preparation of papers / reports and / or oral presentations.

The proposed activities (SE2) will be considered non recoverable activities and mandatory to pass the subject, being necessary to score an average greater than or equal to 5.

The qualification of the subject, both in first and second call, will be obtained as result of the following expression:

Qualification = 0.7* (SE1) +0.3 * (SE2)

Students who do not pass the subject in the first call must carry out the examination (SE2) of the second call in which the evaluation will consist of an exam with two parts: a theoretical one, in which the student must show knowledge of the concepts and relationships seen in the classroom, and a second one where the students must show their ability to apply this knowledge to problems where the most important aspect is the approach to the solution, giving value specially to their ability to extract information from the statement and propose the resolution of the problem. Each of these parts may have a different weight in the qualification of the exam.

In any case, the system of evaluation will be ruled by the established in the Regulation of Evaluation and Qualification of the University of Valencia for Degrees and Masters.

(http://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf).

REFERENCES

Basic

- Radio-Frequency and Microwave Communication Circuits: Analysis and Design, 2nd Edition. D. K. Misra, Ed. Wiley-Interscience, 2004. Online ISBN: 0-471478-73-3
- Radio Frequency Circuit Design, 2nd Edition. W.A. Davis. Ed. Wiley-IEEE Press, 2010. Online ISBN: 9781118099476
- Estado Sólido en Ingeniería de radiocomunicación. H.L. Krauss, C.W. Bostian, F.H. Raab. Ed. Limusa, 1984. ISBN 968181729X
- Fundamentals of Photonics. E. A. Saleh, Malvin Carl Teich, Ed. Wiley, 1991. Online ISBN: 978-0-471-21374-1
- Photonic Devices, Jia-Ming Liu, Ed. Cambridge, 2005. Online ISBN: 978-0-511-61425-5
- Integrated Optics: Theory and Technology, R. G. Hunsperger, 6th Edition, Ed. Springer, 2009. Online ISBN: 978-0-387-89775-2
- Silicon Photonics: An introduction, G.T. Reed, A.P. Knights, Ed. Wiley, 2004. Online ISBN: 978-0-470-01418-9

Additional

- Modern communication circuits. J. Smith. McGraw-Hill, 1998. ISBN: 0071155864
- Electrónica de comunicaciones. M. Sierra. Pearson, 2003. Online ISBN: 9788483229811

- Optoelectronics: an introduction to materials and devices, J. Singh, Ed. Mc Graw-Hill, 1996. ISBN: 0070576505
- Optoelectronics, E. Uiga, Ed. Prentice-Hall, 1995. ISBN: 0132067986
- Fiber-Optic Communications Technology, D.K. Mynbaev, L.L. Scheiner, Ed. Prentice-Hall, 2001. ISBN: 0139620699
- Integrated Photonics: Fundamentals, G. Lifante, Ed. Wiley, 2003. Online ISBN: 978-0-470-86140-0