Universitat Politècnica de Catalunya BarcelonaTech

Last update: 06-05-2019

230634 - LTM - Laser, Terahertz and Microwave Research and Applications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2019
Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Pradell Cara, Lluis

Others: A.Aguasca, I.Corbella, N.Duffo, J.O'Callaghan, J. Mateu, L. Pradell, F. Torres, Santos Blanco, María Concepción

Prior skills

- Electromagnetic theory : wave equation, TEM, TE and TM propagation, boundary conditions, concepts of energy and power, lossless and lossy media, good conductor
- Transmision line parameters
- Transmision line analysis under sinusoidal steady-state condition
- Smith Chart applied to the calculation of transmision line impedances/admitances and reflection coefficients
- S parameters
- Optical fiber basics. Optical modulation systems
- Lasers and optical detectors

Requirements

- Circuit theory (or equivalent)
- Electromagnetic theory (or equivalent)
- Radiation & guided waves (or equivalent)
- Microwave theory (or equivalent)
- Optical Communications (or equivalent)

Degree competences to which the subject contributes

Specific:

1. Ability to apply advanced knowledge in photonics, optoelectronics and high-frequency electronic

2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.
3. Ability to implement wired/wireless systems, in both fix and mobile communication environments.

4. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

Transversal:

5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
6. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of

contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology

- Individual resolution of theoretical exercises.
- Group project consisting of design, implementation and measure of a microwave circuit/system such as an amplifier, using ADS/Momentum and da2 software tools.
- Laboratory practice performed by groups.

Learning objectives of the subject

- Introduction to specific techniques for the analysis of microwave circuits (S parameters)
- Application to various passive and active subsystems, such as divider/combiner networks, filters, small-signal, large-signal and broadband amplifiers, oscillators and mixers
- Introduction and application of software tools, such as ADS, to the analysis of microwave circuits.
- Design, implementation (fabrication) and measurement of passive and active circuit examples
- Theory and practical utilisation of basic laboratory instruments: network analyzer, spectrum analyzer and noise analyzer.
- Terahertz technology and applications
- Optical methods for Terahertz generation

Study load

Total learning time: 125h	Hours large group:	26h	20.80%
	Hours small group:	13h	10.40%
	Self study:	86h	68.80%

Content

1 Advanced topics in RF and Microwave circuit analysis

Learning time: 63h

Theory classes: 7h
Laboratory classes: 13h
Self study : 43h

Description:
Electromagnetic/circuit co-simulation and optimization of planar structures. Advanced design techniques for passive circuits (microwave filters and power combining/dividing circuits). Linear and non-linear analysis of active circuits (amplifiers, mixers, oscillators). Laboratory characterization techniques. Measurements of circuits designed, simulated and fabricated during the course.

(ENG) 2. Terahertz (THz) Photonics

Learning time: 62h

Theory classes: 13h
Laboratory classes: 6h
Self study : 43h

Description:
Fundamentals of THz technology and applications: time- and frequency-domain spectroscopic systems, and applications to imaging and communications. Basic characteristics of the different methods for THz radiation generation and detection: purely electronic methods such as frequency multiplication, and purely optical methods such as quantum cascade lasers (QCL). In-depth examination of the more ubiquitous photoconductive and optical rectification based systems: focus on quantitative practical examples and experimental setups.

Qualification system

Project (design, practical implementation and measure): 45 % (group)
Individual exercises: 25 % (group)
Final examination: 30 % (individual)

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Bibliography

Basic:

González, G. Microwave transistor amplifiers: analysis and design. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall, 1997. ISBN 0132543354.

Pozar, D.M. Microwave engineering. 4th ed. Hoboken: Wiley, 2012. ISBN 9780470631553.

Complementary:

Bahl, I.; Bhartia, P. Microwave solid state circuit design. 2nd ed. New York: Wiley-Interscience, 2003. ISBN 9780471207559.

Cameron, R.J.; Kudsia, C.M.; Mansour, R.R. Microwave filters for communication systems: fundamentals, design, and applications. Hoboken, N.J.: Wiley-Interscience, 2007. ISBN 9780471450221.

Others resources:

Course notes and presentations corresponding to the different topics covered. Course notes are delivered to students registered in the course through the UPC Atenea digital campus (http://atenea.upc.edu:8080/moodle/)