UE Specialty courses

Level
Baccalaureate +5

ECTS
3 credits

Component
UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)

- **Teaching language(s):** English
- **Teaching method:** In person
- **Teaching type:** Lectures
- **Open to exchange students:** Yes
- **Code d'export Apogée:** PAX9ICAF

Presentation

Description

This teaching module will be divided into 4 parts :

- ***Design for test - 8 hours - 0.75 ECTS***

This teaching module provides a comprehensive description of test methods for RF ICs.Content: Introduction to RF production testing (What is test? Characterization vs. verification vs. production testing; IC testing methodology, objectives, challenges; Modeling the cost of test); Current industrial practice for RF testing (Testing RF stand-alone ICs: basic measurements such as power, noise, gain, linearity, S-parameters for low noise amplifiers, mixers, power amplifiers, etc; Testing RF transceivers: receiver and transmitter tests); Advanced test techniques (Design for Test (DfT) solutions; Built-In Self-Test (BIST) solutions; Practical case studies: loopback test, RF power detectors, envelope detectors, current sensors, non-intrusive process monitors, temperature sensors, etc); State-of-the-art research papers reading and discussion.

- ***Radio Frequency IDentification Technologie - 8 hours - 0.75 ECTS***

This teaching module allows understanding the problematic of the integration of sensors in RFID systems : use and implementation of a UHF RFID system; Realization of a RFID system from basic electronic bricks; Design and characterization of a RFID tag.

Content: Introduction, history and use case of the RFID technology; Basics of RFID; RF concepts of UHF RFID : Radar cross section, backscattering wave, load modulation; UHF RFID reader : modulation, transceiver, smart antenna; UHF RFID tag : design, energy harvesting, sensor; UHF RFID protocol : communication protocol between the reader and the tag; The future of RFID.

- ***Electrooptic sensors & Bio electromagnetism - 8 hours - 0.75 ECTS***

The aim of this module is to give an overview of the existing techniques related to the electric field analysis within harsh environments. More precisely, this course will explain both the fundamentals of optical modulations in non-linear crystals and how to exploit this phenomena to develop suitable sensors. A focus will be dedicated to the influence of the ambient media on the sensor behavior. Examples of measurements in biological media and in ionized media with specific electro-optic sensors will be given.

Content: Introduction and context: why measuring the electric (E) field ? requirements for E-field measurement; definition of relevant characteristics for E-field sensors; benchmarking of exiting sensors; Optical sensor for the E-field vectorial analysis; Active sensors : principles & perfomances; Example of field assessment; Passive sensors: principles & perfomances; Example of field assessment in air, in biological media; Example of intense field assessment associated to partial or total discharge; Example of intense field assessment in the vicinity of plasmas for biomedical applications.
- ***Tunable RF - Technologies & Applications - 8 hours***
- 0.75 ECTS

The need for wireless devices with improved battery life, smaller form factor, and reduced cost is driving research towards flexible RF Front-End Modules (FEM) with a high integration level to efficiently afford multimode multi-band requirements. Today's RF FEM are mostly addressed by multiple modules using a large set of technologies which lead to large and costly solutions. As the push for further cost and size reduction goes on, many research activities and industrial efforts are currently on going to improve RF FEM integration level by introducing new technologies and design techniques. The proposed teaching module will provide an overview of technologies and advanced design techniques for the implementation of high performance tunable RF building blocks and RF FEM.

Content: Design and analysis of reconfigurable RF circuits (PA, Filter,…) and RF FEM. Topics Include: RF FEM and PA architectures; Technologies for tunable RF design; Tunable PA architecture and design; Tunable RF Filter architecture and design; Tunable matching design; Antenna tuning.

Course parts

UE Specialty courses - CMTD	Lectures (CM) & Teaching Unit (UE)	32h

Recommended prerequisites

Basic calculus and signal processing (FFT, etc.)

Basic circuit theory.

Basic analog and RF design.

Basic RF device physics and models

Basics on electronics and wireless system.

Basics of radiation and RF.

Period : Semester 9

Bibliography

Design for test:

- K. B. Schaub and J. Kelly, Production testing for RF and System on Chip devices for wireless communications, Artech House Microwave library, 2004.
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- M. Burns and G. W. Roberts, An Introduction to Mixed-Signal IC Test and Measurement. Oxford University Press, 2nd ed., 2011.

Radio Frequency IDentification Technologies:

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- K. Finkenzeller, RFID-Handbook-Fundamentals-and-Applications-in-Contact-Less-Smart-Cards-and-Identification, 2003.

- D. Parret, RFID at Ultra and Super High Frequencies: Theory and application, Wiley, 2010.

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- D. V. Giri and F. M. Tesche. Classification of intentional electromagnetic environments. IEEE Trans. Electromagn. Compat., 46 :323–329, 2004.
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- G. Gaborit. Caractérisation de champs électriques hyperfréquences par capteurs électro-optiques vectoriels fibrés. PhD thesis, Universite de Savoie, 2005.
- P. Jarrige R.P. O'Connor G. Gaborit L. Duvillaret D. Arnaud-Cormos N. Ticaud, S. Kohler and P. Leveque. Specific absorption rate assessment using simultaneous electric field and temperature measurements. IEEE Ant. Wire. Prop. Lett., 11 :252–255, 2012.

Tunable RF - Technologies & Applications:

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- Cheng, Nick; Young, J.P., "Challenges and Requirements of Multimode Multiband Power Amplifiers for Mobile Applications," *Compound Semiconductor Integrated Circuit Symposium (CSICS), 2011 IEEE* , pp.1,4, 16-19 Oct. 2011.

- B. Kim, D. Kang, D. Kim, Y. Cho, J. Kim, “Reconfigurable Power Amplifiers for Handset Applications”, October 2010, Available at www.postech.ac.kr

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- Whatley, R.; Ranta, T.; Kelly, D., "CMOS based Tunable Matching Networks for cellular handset applications," *Microwave Symposium Digest (MTT), 2011 IEEE MTT-S International* , vol., no., pp.1,4, 5-10 June 2011.

- Taeyeop Lee; Bum-kyum Kim; Donggu Im; JaeSub Oh; Kwyro Lee, "High-power tunable matching circuit using SOI-CMOS digitally programmable capacitor array for 4G mobile handsets," *Wireless Information Technology and Systems (ICWITS), 2012 IEEE International Conference on* , vol., no., pp.1,4, 11-16 Nov. 2012.

- Unha Kim; Sungyoon Kang; Jungrin Woo; Youngwoo Kwon; Junghyun Kim, "A Multiband Reconfigurable Power Amplifier for UMTS Handset Applications," *Microwave Theory and Techniques, IEEE Transactions on* , vol.60, no.8, pp.2532,2542, Aug. 2012.

Useful info

Place

Grenoble

Campus

Grenoble - Scientific Polygon