TEACHING GUIDE ON

Characterization, simulation and modeling of electronic nanodevices

(updated: 07/05/2019)
Academic year: 2019-20

MODULE	TOPIC	SUBJECT	COURSE	SEMESTER	ECTS	CHARACTER
Nanotechnology			1	2	6	Optional

LECTURERS	CONTACT
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	TUTORING SCHEDULE
	https://oficinavirtual.ugr.es/ai/ -> ordenación docente -> tutorías
MASTER	
University Master in Physics: Radiations, Nanotechnology, Particles and Astrophysics, University of Granada	

PRE-REQUISITES FOR REGISTRATION

Basic knowledge on Semiconductors and Electronics

BRIEF DESCRIPTION OF CONTENTS

Carrier-scattering mechanisms.
Charge transport in electronic nanodevices.
Numerical simulation and compact modeling techniques. Monte Carlo method.
Electrical characterization tools and techniques.
Noise in electronic nanodevices.

OBJETIVES

The student will be able:

-To use the main simulation tools in electronic nanodevices.
-To solve Poisson, Schrödinger, continuity, and transport equations with different techniques.

-To face transport problems in different structures and to determine the band structure.

-To propose a compact model for circuit simulation.
-To implement compact models in commercial circuit simulators.
-To extract the parameters of compact models.
-To use advanced numerical techniques employed in modeling and parameter extraction

-To distinguish the different types of noise present in electronic nanodevices.
-To measure electronic noise.
-To determine physical parameters in an electronic device from noise measurements.
-To use mathematical tools to treat the electronic noise.
-To extract parameters of device models based on noise measurements.

CONTENTS OF THE COURSE

1.- Basic notions on field effect transistors.
2.- Numerical methods for the solution of Poisson, Schrödinger and Boltzmann equations.
3.- Carrier-scattering mechanisms: surface roughness, Coulomb interactions, lattice vibrations, carrier-carrier interactions.
4.- Single- and multi-particle Monte Carlo method. Application to the charge transport in semiconductors.
5.- Compact model methodology in electronic devices.
6.- Advanced analytical solution of differential equations and approximation methods.
7.- Parameter extraction methods for electronic device models.
8.- Noise in electronic devices. Mathematical methods.
9.- Types of noise and their localization in an electronic device.
10.- Characterization of an electronic device from noise measurements.

REFERENCES

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-Taur, Y. and Ning T.H.; "Fundamentals of modern VLSI devices", Cambridge University Press, 1998
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-Selberherr, S. "Analysis and simulation of semiconductor devices", New York: Springer, 1984.
-Hänsch W.; "The drift-diffusion equation and its applications in Mosfet modeling", Springer-Verlag New-York Inc, 1991
-Moglestue. C. "Monte Carlo simulation of semiconductor devices", Chapman&Hall, 1993
-C.Jacoboni and P.Lugli, "The Monte Carlo method for semiconductor device simulation", Springer Verlag, 1989
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-Van der Ziel, "Noise in solid state devices and circuits", New York. Wiley. 1986.
-Y.P. Tsividis, "Operation and Modeling of the Metal-oxide Semiconductor transistor", Mcgraw hill, 1999.
-C. Galup-Montoro, M.C. Schneider, "MOSFET modeling for circuit analysis and design", World Scientific, 2007.
-C. Enz and E.A. Vittoz, "Charge-Based MOS Transistor Modeling: The EKV Model for Low-Power and RF IC Design". New York: Wiley, 2006.
-A.B. Bhattacharyya "Compact MOSFET models for VLSI design", John Wiley and Sons, 2009.

USEFUL LINKS

http://www.arxiv.org/
http://www.aip.org/

METHODOLOGY

Lectures: To transmit the contents of the subject, motivating the students to reflection, facilitating the discovery of relationships between different concepts and promoting a critical mindset.

Seminars: To develop in the students the cognitive and procedural skills of the subject.

Academic tutoring: To guide the autonomous and team work of students, focusing on different aspects of the subjects and guide the comprehensive academic training of the student.

Study and independent work of students: To foster in the student the ability to self-regulate their learning, by planning, designing, evaluating and adapting it to their particular conditions and interests.

Teamwork: To encourage students in the generation and exchange of ideas, identification and analysis of different views on a topic, generalization or transfer of knowledge and critical assessment of it.

EVALUATION SYSTEM

- In order to pass the course with the minimum qualification, some interviews and/or exams are compulsory.
- A higher qualification can be obtained if other tasks, supervised works and laboratory practices are done.
- The final qualifications is calculated as: Oral/written exams (50%). Supervised works and laboratory practices (50%)

ADITIONAL INFORMATION