Course guides
230670 - EDM - Electronic Devices Modelling

Last modified: 08/03/2016

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: **Academic year:** 2016 **ECTS Credits:** 5.0
Languages: English

LECTURER

Coordinating lecturer: JUAN MIGUEL LÓPEZ GONZÁLEZ

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

2. 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.

TEACHING METHODOLOGY

- Lectures
- Individual work (distance)
- Exercises
- Oral presentations

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject:

The aim of the Electronic Devices Modeling course is to understand the performance of modern electronic devices using TCAD and Compact Modeling tools. Principles of the DC, AC, RF, Noise, Large-Signal, Temperature, and Optoelectronic modeling of semiconductor devices are explained and their application to modern devices (CMOS, FinFET, CNFET, GFET, HBT, HEMT, LEDs, Solar Cells,¿) is analysed.

Learning results of the subject:

- Ability to understand TCAD and Compact Modeling tools of electronic devices.
- Ability to understand the principles of the DC, AC, RF, Noise, Large-Signal, Temperature, and Optoelectronic performance of semiconductor devices.
- Ability to analyze and develop models of field effect devices: CMOS, FinFET, CNFET, and GFET.
- Ability to analyze and develop models of bipolar devices: BJT, and HBT.
- Ability to analyze and develop models of optoelectronic devices: Solar Cells and LEDs.
- Ability to understand electrical function of modern electronic devices: Field Effect Devices, Bipolar Devices and Optoelectronic Devices.
- Ability to understand DC, AC, RF, Large-Signal, Noise and Temperature performance of electronic devices.
- Ability to model electronic semiconductor devices using TCAD tools.
- Ability to develop analytical and compact models for low and high frequency integrated electronic devices.

STUDY LOAD

Type	Hours	Percentage
Self study	86,0	68.80
Hours large group	39,0	31.20

Total learning time: 125 h

CONTENTS

1. Introduction

Description:
Introduction to TCAD and compact modeling

Specific objectives:
? Subject contents and presentation
? Compact modeling
? TCAD modeling

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

2. Technology Computer Aided Design (TCAD) Modeling: using ATLAS

Description:
Technology Computer Aided Design (TCAD) Modeling: using ATLAS

Specific objectives:
? Structure
? Materials
? Mathematics

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

3. Compact Modeling: using IC-CAP and MATLAB

Description:
Compact Modeling: using IC-CAP and MATLAB

Specific objectives:
? IC-CAP Basic
? MATLAB Basic

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

4. Semiconductors

Description:
Theory and modeling of Semiconductors

Specific objectives:
? Semiconductor equations
? Energy band parameters
? Material parameters

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

5. Junctions

Description:
Theory and modeling of Junctions

Specific objectives:
? PN homojunctions
? Heterojunctions

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

6. Metal-semiconductor junctions

Description:
Theory and modeling of Metal-semiconductor junctions

Specific objectives:
? Metal-semiconductor theory
? Metal-semiconductor TCAD

Full-or-part-time: 6h 18m
Theory classes: 0h 18m
Self study : 6h

7. Graphene

Description:
Theory and modeling of Graphene

Specific objectives:
? Graphene physics
? Graphene electrical properties
? Applications of Graphene

Full-or-part-time: 6h 18m
Theory classes: 0h 18m
Self study : 6h

8. Optoelectronics modeling

Description:
Theory and modeling of optoelectronics devices

Full-or-part-time: 6h 18m
Theory classes: 0h 18m
Self study : 6h

9. Direct current (DC) modeling

Description:
Direct current (DC) modeling of electronic devices

Specific objectives:
? DC datasheets
? DC measurements
? DC modeling

Full-or-part-time: 6h 18m
Theory classes: 0h 18m
Self study : 6h

10. Alternating current (AC) modeling

Description:
Alternating current (AC) modeling of electronic devices

Specific objectives:
? AC datasheets
? AC measurements
? AC modeling

Full-or-part-time: 6h 18m
Theory classes: 0h 18m
Self study : 6h

11. Radio frequency (RF) and Microwave modeling

Description:
Radio frequency (RF) and Microwave modeling of electronic devices

Specific objectives:
? RF and Microwave datasheets
? RF and Microwave measurements
? RF and Microwave modeling

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

12. Noise modeling

Description:
Noise modeling of electronic devices

Full-or-part-time: 9h
Theory classes: 3h
Self study : 6h

ACTIVITIES

EXERCISES

Description:
Exercises to strengthen the theoretical knowledge.

INDIVIDUAL HOMEWORK

Description:
Modeling of an electronic device.

ORAL PRESENTATION

Description:
Presentation of a work about modeling of an electronic device.

GRADING SYSTEM

Exercises: from 50 % to 70 %
Individual assessments: from 20 % to 40 %
Oral presentations: from 10 % to 20 %

BIBLIOGRAPHY

Basic:
- Pulfrey, D.L. Understanding modern transistors and diodes. Cambridge ; New York: Cambridge University Press, 2010. ISBN 9780521514606.

RESOURCES

Other resources:
User manuals of ATLAS-SILVACO TCAD (www.silvaco.com) and ICCAP-Agilent Compact Modeling (www.agilent.com) softwares.