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230670 - EDM - Electronic Devices Modelling

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2016

Degree: DEGREE IN ELECTRONIC ENGINEERING (Syllabus 1992). (Teaching unit Optional)
ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: JUAN MIGUEL LÓPEZ GONZÁLEZ

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.

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- Ability to develop analytical and compact models for low and high frequency integrated electronic devices.

Study load

Total learning time: 125h	Hours large group:	39h	31.20%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

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Content

1. Introduction

Learning time: 9h

Theory classes: 3h
Self study : 6h

Description:
Introduction to TCAD and compact modeling

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

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

Learning time: 9h

Theory classes: 3h
Self study : 6h

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

Specific objectives:
? Structure
? Materials
? Mathematics

3. Compact Modeling: using IC-CAP and MATLAB

Learning time: 9h

Theory classes: 3h
Self study : 6h

Description:
Compact Modeling: using IC-CAP and MATLAB

Specific objectives:
? IC-CAP Basic
? MATLAB Basic

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4. Semiconductors

Learning time: 9h

Theory classes: 3h
Self study : 6h

Description:
Theory and modeling of Semiconductors

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

5. Junctions

Learning time: 9h

Theory classes: 3h
Self study : 6h

Description:
Theory and modeling of Junctions

Specific objectives:
? PN homojunctions
? Heterojunctions

6. Metal-semiconductor junctions

Learning time: 6h 18m

Theory classes: 0h 18m
Self study : 6h

Description:
Theory and modeling of Metal-semiconductor junctions

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

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7. Graphene

Learning time: 6h 18m

Theory classes: 0h 18m
Self study : 6h

Description:
Theory and modeling of Graphene

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

8. Optoelectronics modeling

Learning time: 6h 18m

Theory classes: 0h 18m
Self study : 6h

Description:
Theory and modeling of optoelectronics devices

9. Direct current (DC) modeling

Learning time: 6h 18m

Theory classes: 0h 18m
Self study : 6h

Description:
Direct current (DC) modeling of electronic devices

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

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10. Alternating current (AC) modeling

Learning time: 6h 18m

Theory classes: 0h 18m
Self study : 6h

Description:
Alternating current (AC) modeling of electronic devices

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

11. Radio frequency (RF) and Microwave modeling

Learning time: 9h

Theory classes: 3h
Self study : 6h

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

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

12. Noise modeling

Learning time: 9h

Theory classes: 3h
Self study : 6h

Description:
Noise modeling of electronic devices

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Planning of 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.

Qualification 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.

Others resources:

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