UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

Last update: 24-03-2017

230645 - MNT - Micro and Nanotechnologies

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

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2017

Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 1992). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: JOSEP CALDERER CARDONA

Others: ÁNGEL RODRÍGUEZ MARTÍNEZ

Degree competences to which the subject contributes

Specific:

1. Ability to use semiconductor devices taking into account their physical characteristics and limitations.

2. Ability to analyze and evaluate the performance at the physical level of the main devices and sensors, the relations between magnitudes in their terminals and their equivalent circuits.
3. Ability to establish a relationship between an electronic device and its fabrication technology, and to understand its design process.

Transversal:

4. 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.
5. 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.
6. 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
- Application classes
- Group work (distance)
- Individual work (distance)
- Exercises
- Oral presentations
- Other activities: visit to laboratories
- Short answer test (Control)
- Short answer test (Test)
- Extended answer test (Final Exam)

Learning objectives of the subject

Learning objectives of the subject:

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The aim of this course is the understanding of physical and technological basis of electronic devices in order to use innovative solutions to electronic design problems. Emphasis is on MOS field-effect transistors and their behaviors (Fin FET, TFT,etc), Power devices, Nano devices and sensors.

Learning results of the subject:

- Ability to use modelling tools of semiconductor devices.
- Ability to define basic fabrication processes.
- Ability to decide between technological alternatives.

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%

Content

1. Field effect transistors and advanced devices

Learning time: 29h

Theory classes: 9h
Guided activities: 6h
Self study : 14h

Description:
- Review of Metal-oxide-semiconductor field effect transistor (MOSFET) standard model
- MOSFET downscaling
- Thin film transitors (TFT)
- Junction (JFET) and Metal-semiconductor (MESFET) field effect transistors
- Devices based on heterojunctions: High Electron Mobility Transistors (HEMT) and Heterojunction Bipolar Transistors (HBT)
- Advanced topics

2. Power devices

Learning time: 33h 30m

Theory classes: 10h 30m
Guided activities: 7h
Self study : 16h

Description:
- Diodes
- Bipolar transistors
- Thyristors (SCR, DIAC, TRIAC, etc.)
- Metal-oxide-semiconductor field effect transistor (MOSFET)
- Insulated gate bipolar transistor (IGBT)

3. Fabrication technology

Learning time: 19h

Theory classes: 6h
Guided activities: 4h
Self study : 9h

Description:
- Semiconductor materials
- Doping techniques
- Layer growth
- Lithography
- Epitaxy
- Process integration

4. Sensors	Learning time: 29h Theory classes: 9h Guided activities: 6h Self study : 14h

Description:
- Mechanical
- Chemical
- Electromagnetic
- Optical
- Thermal

5. Advanced Materials	Learning time: 14h 30m Theory classes: 4h 30m Guided activities: 3h Self study : 7h

Description:
- Carbon nanotubes
- Polymers
- Porous silicon

Planning of activities

EXERCISES

Description:
Exercises to strengthen the theoretical knowledge.

MIDTERM EXAMINATION

Description:
Test on the evolution of students by half semester.

EXTENDED ANSWER TEST (FINAL EXAMINATION)

Description:
Final examination.

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Qualification system

Final examination: from 60%
Individual assessments: from 40%

Bibliography

Basic:

Sze, S.M.; Ng, K.K. Physics of semiconductor devices. 3rd ed. Hoboken, NJ: John Wiley & Sons, 2007. ISBN 9780471143239.

Complementary:

Mitin, V.V.; Kochelap, V.A.; Strocio, M.A. Quantum heterostructures: microelectronics and optoelectronics. Cambridge, UK: Cambridge University Press, 1999. ISBN 0 521 63177 7.

Mitin, V.V.; Kochelap, V.A.; Strocio, M.A. Introduction to nanoelectronics: science, nanotechnology, engineering, and applications. Cambridge: Cambridge University Press, 2008. ISBN 978-0-521-88172-2.

Widman, D.; Mader, H.; Friedrich, H. Technology of integrated circuits. Berlin: Springer, 2000. ISBN 3-540-66199-9.

Baliga, B.J. Power semiconductor devices. Boston: PWS, 1996. ISBN 0534940986.