



Course guide

2301210 - FPE - Flexible and Printed Electronics

Last modified: 18/04/2024

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 1042 - URV - Universitat Rovira i Virgili.

Degree: MASTER'S DEGREE IN SEMICONDUCTOR ENGINEERING AND MICROELECTRONIC DESIGN (Syllabus 2024).
(Optional subject).

Academic year: 2024 **ECTS Credits:** 4.0 **Languages:** English

LECTURER

Coordinating lecturer: Iñiguez Nicolau, Benjamí

Others: Cirera Hernández, Albert
Ramon Garcia, Eloi
Gabriel Buguña, Gemma
Marsal Garvi, Lluís Francesc

PRIOR SKILLS

- 1) Understanding of the physics and operation basic semiconductor devices (in particular diodes and MOSFETs) and their fabrication processes.
- 2) Understanding of basic integrated circuit design.
- 3) Understanding of basic delectron evice characterization techniques.

TEACHING METHODOLOGY

Theoretical lectures and problems: 18 h. Laboratory exercises: 12 h

LEARNING OBJECTIVES OF THE SUBJECT

1. Be able to understand and devise potential solutions for the challenges faced by the microelectronic industry in the context of flexible and printed electronics.
2. Understand the main fabrication processes of devices for flexible and printed electronics.
3. Get to know the physical properties of materials used in these applications.
4. Understand the physics and operation of devices used in flexible and printed electronics, as well as solutions to increase their performance.
5. Get to know and understand the main applications in flexible and printed electronics, as well as the architectures needed for them.

STUDY LOAD

Type	Hours	Percentage
Hours small group	12,0	12.00
Self study	70,0	70.00
Hours large group	18,0	18.00

Total learning time: 100 h



CONTENTS

Materials

Description:

Brief review of the fundamentals of flexible materials. Physics of amorphous semiconductor and organic materials. Substrates. Conductive inks. Dielectrics. Interfaces and contacts for flexible and printed electronics. Mechanics of thin film-on-flexible substrate structure.Characterization

Specific objectives:

Get to know the physical properties of materials used in flexible and printed electronics.

Related activities:

- 1) Problems and solutions.
- 2) Laboratori exercise: Modification of inks and interaction with substrates.

Full-or-part-time: 7h 15m

Theory classes: 4h

Laboratory classes: 3h

Self study : 0h 15m

Fabrication processes

Description:

Solution processes. CVD, PECVD and VPD deposition techniques. Micro/nano fabrication on flexible substrates. Printing methods: inkjet printing, screen printing, gravure, electrospray, R2R,...3D printing. Sintering. Coating and encapsulation

Specific objectives:

Understand the main fabrication processes of devices for flexible and printed electronics.

Related activities:

- 1) Problems and solutions
- 2) Laboratory exercise: Fabrication of components by printing methods

Full-or-part-time: 8h 20m

Theory classes: 5h

Laboratory classes: 3h

Self study : 0h 20m

Devices

Description:

Structure of the devica and doping profile, manufacturing and materils of TFT MOS devices. Characteristics and models.

Specific objectives:

Thin Film Transistors (TFTs): types. Thin Film Transistors: physics, operation and modeling. Other devices for flexible and printed electronics: diodes, LEDs, OPV, sensors. Reliability.

Related activities:

- 1) Problems and solutions.
- 2) Laboratory exercise: Simulation of Thin Film Transistors with TCAD (process and performance)

Full-or-part-time: 8h 20m

Theory classes: 5h

Laboratory classes: 3h

Self study : 0h 20m



Applications

Description:

Flexible Hybrid Electronics. Large area electronics, displays and sensor arrays. Design of Flexible Electronics circuits. Wearable health monitoring. Bioelectronics. Wireless applications and IoT sensors.

Specific objectives:

Get to know and understand the main applications in flexible and printed electronics, as well as the architectures needed for them.

Related activities:

Problems and solutions.

Full-or-part-time: 4h 15m

Theory classes: 4h

Self study : 0h 15m

GRADING SYSTEM

Exam (two partial exams, 2nd call exam): 60%

Laboratory exercises: 40%

EXAMINATION RULES.

Written exams: questions and problems.

Reports of the laboratory exercises.

BIBLIOGRAPHY

Basic:

- Suganuma, K. Introduction to printed electronics [on line]. New York, NY: Springer Nature, 2014 [Consultation: 02/05/2024]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-1-4614-9625-0>. ISBN 9781461496250.
- Hussain, A.M. Introduction to flexible electronics [on line]. Boca Raton, FL: CRC Press, 2022 [Consultation: 06/05/2024]. Available on : <https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.1201/9781003010715/introduction-flexible-electronics-aft-ab-hussain>. ISBN 9781003010715.
- Brotherton, S.D. Introduction to thin film transistors: physics and technology of TFTs [on line]. Cham: Springer International Publishing, 2013 [Consultation: 02/05/2024]. Available on : <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-319-00002-2>. ISBN 9783319000022.