UAB
Universitat Autònoma de Barcelona

Nanomanufacturing

Code: 106835
ECTS Credits: 6

2025/2026

Degree	Type	Year
Nanoscience and Nanotechnology	OB	3

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is recommended to have passed the subjects of the three previous courses, especially those related to the areas of physics, engineering and electronics.

Objectives and Contextualisation

The objective of the module is to present the techniques and methods that exist of manufacture at a micro and nanometric scale, so that the student will be capable of defining an appropriate sequence of processes for the realization of any type of device or functional structure. The content is focused on the manufacture of structures and functional devices, and not on the obtaining of materials. There will be practical and varied examples of fabrication of nanometric structures and devices (nanomechanical structures, graphene-based devices, nanosensors, photonic devices, micro / nano fluidic, etc.). An introduction to the operation and execution of processes in a Clean Room will also be carried out.

Learning Outcomes

1. CM25 (Competence) Propose optimal synthesis, fabrication and characterisation methods based on the desired properties and functionalities of nano-systems.
2. CM26 (Competence) Design nano-systems that meet the requirements of specific innovative applications.
3. CM27 (Competence) Work in teams to develop practical cases in the field of nanotechnology and assess their social, economic and environmental impact.
4. KM47 (Knowledge) Describe the main industrial manufacturing and processing processes for devices at the micro and nanoscale.
5. SM39 (Skill) Carry out micro and nanofabrication processes to obtain devices and systems at the nanoscale.
6. SM40 (Skill) Use digital tools and documentary sources to obtain, analyse and present information from a critical perspective in the field of nanotechnology.

Content

The subject is divided into four main blocks:

Module 1. Planar technology

The main processes of planar technology are described individually and the general aspects of micro / nano electronics technology are presented, as well as their evolution (miniaturization)

Introduction to planar technology: concept, waffers, sequence of processes, etc.
Individual technological processes: deposition (PVD and CVD), engravings (dry and wet), thermal processes, implantation, lithography.
Integration of processes, CMOS technology.
Evolution and limits of micro / nano electronics

Module 2. Nanolithography and "nanopatterning"

Lithography and nanopatronization techniques are described for the definition of nanostructures and nanodevices in surfaces. Examples of the current state of the art are presented.

Advanced optical lithography
Lithography by electron beam
Lithograph by ion beam
Nanoimprint lithography
Nanofabrication through SPMs
Other nanolithographies

Module 3 Nanofabrication "bottom-up"

We describe methods for performing nanostructures and devices based on a "bottom-up" approach, based on the assembly of individual nanometric elements to build structures and functional devices.

Self assembly and guided self assembly.
Structures and devices based on nanofiles and nanotubes
Structures and devices based on nanoparticles
Other methods of chemical and electrochemical manufacturing

Module 4 Practical work on nanofabrication

The student is introduced to the principles of operation of a Clean Room and to the methodology of design of masks and micro-chips.

- Design of a mask with a dedicated software (two sessions).
- Complete photolithography process using the designed mask (one session).

- Deposition and etching of thin layers. Characterization of the layers by AFM (one session).
- Observation with electron microscope of bottom-up structures (one session).
- Guided tour of the clean room of the National Center for Microelectronics (one session).

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercices	6	0.24	
Laboratory	14	0.56	
Seminars (Laboratory)	8	0.32	
Theory	24	0.96	
Type: Autonomous			
Reading of the class notes	30	1.2	
Reading of the guides of practices of laboratory	20	0.8	
Work on exercises and tests	32	1.28	

Teaching will consist on 24 hours of theory lectures, 6 hours of problems and 22 hours of laboratory practices (8 hours about seminars related with laboratory).

Practical sessions: The practical sessions and their corresponding reports will be carried out in groups of a maximum of two students. Groups formed by more than two students will not be accepted. The delivery of the reports will be governed by a deadline that will be communicated after having done the practice, via virtual campus.

Extra exercises: During the course, extra exercises may be given to the students that must be done out of the teaching hours and which will be evaluable.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
laboratory reports	30%	10	0.4	CM27, KM47, SM39, SM40
Partial exams	65%	6	0.24	CM25, CM26

There will be the following evaluation activities:

Two partial exams (theory and problems), one at the mid-term and the other at the end, with a weight under the final qualification of 70% (35% each). Attendance to these partial exams is mandatory to access to the recovery exam.

Reports corresponding to laboratory practices with a weight on the final qualification of 30%. This note will be taken into account for the final evaluation provided that the student exceeds the qualification of 4.5 as an average of the two partials or as a qualification of the recovery exam.

NOTE: Attendance at the practical sessions and the delivery of the corresponding report are a mandatory condition for the student to be evaluated.

Exam (theory and problems) for recovery: Attendance to the recovery exam will be recommended if you have obtained a qualification of less than 5 in one of the two partial exams. It will have a weight of 70% of the final qualification. The contents referring to the first partial and the second will be assessed separately. This allows presentation to the recovery of a partial or total contents of the subject. Final qualification of the exams (70% of the final subject qualification) will be the averaging between the two parts of the subject, choosing for each part the best qualification between the partial exam and the recovery exam.

Single assessment modality:

Students who have accepted the single assessment modality will have to take a single final test which will consist of an exam with a theory part and a problem part where they will have to solve a series of exercises similar to those they have worked in the Classroom Practice sessions. On the same day that they take the written test, they must hand in the reports of all the practices sessions (laboratory sessions). This exam and the delivery of all practice reports will take place on the day of the second partial exam set for continuous assessment students by the degree coordination. The written exam (theory and problems) will be delivered on paper and the practicals in PDF format via virtual campus.
The student's final grade will be as follows: the written exam (theory and problems) will have a weight of 70% of the final grade and the practical reports a total of 30%. The grade of the practice reports will be taken into account for the final grade only if the student has passed the grade of 4.5 in the written exam (theory and problems) or in the recovery exam.
If the final grade does not reach 5, the student has another opportunity to pass the subject through the recovery exam that will be held on the date set by the degree coordinator. In this test you can recover 70% of the grade corresponding to the theory and the problems. The laboratory practices part is not recovered.

Bibliography

Introduction to Microfabrication / Sami Franssila. ISBN 978-0-470-74983-8, John Wiley & Sons, 2010.

Nuevas Tecnologías en los Dispositivos Electrónicos / A. Godoy et. al: Departamento de Electrónica y Tecnología de Computadores, Universidad de Granada, ISBN: 978-84-691-4090-1, 2008.

Nanofabrication, Nanolithography techniques and their applications / José María de Teresa et al. / Online ISBN: 978-0-7503-2608-7 • Print ISBN: 978-0-7503-2606-3, 2020.

Nanofabrication, Techniques and Principles / Maria Stepanova & Steven Dew / ISBN 978-3-7091-0423-1, Springer, 2012.

Optical Lithography, Here is Why / Burn J. Lin / ISBN 978-0-8194-7560-2 Spie Press, 2010.

Fundamentals of microfabrication and nanotechnology / Marc J. Madou; Boca Raton, FL Taylor & Francis, 2011.

Articles published in research journals. The professors will provide the appropriate information.

Software

All of the software works on windows platform.

Glade and KLayout softwares (both are about lithography masks design, open access)

Gwyddion (image analysis, open access)

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	afternoon
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan	second semester	morning-mixed
(SEM) Seminars	1	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	2	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	3	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	4	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	5	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	6	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	7	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	8	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	9	Catalan/Spanish	second semester	morning-mixed
(SEM) Seminars	10	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	afternoon