Course guide
2301202 - SFDM - Semiconductor Facilities and Device Manufacturing

Last modified: 20/03/2024

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

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

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/curs-actual/coordinadors-i-professorat

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/curs-actual/coordinadors-i-professorat

PRIOR SKILLS

Microelectronic Technologies and Processes, Microelectronic design

TEACHING METHODOLOGY

Expository method, participatory lecture, problem-based learning and case studies

LEARNING OBJECTIVES OF THE SUBJECT

1. Explore cleanroom facilities, equipment, safety protocols, operation, and impact on the environment.
2. Acquire practical knowledge of microelectronic processes and access to external foundries for the manufacture of semiconductor devices.
3. Know how to identify and apply cleanroom technological processes for the manufacture of devices and integrated circuits.
4. Characterise and identify critical aspects in process integration to maximise the likelihood of success in a complete cleanroom manufacturing process.
5. Develop critical thinking and problem-solving skills relevant to semiconductor manufacturing, especially oriented to process integration.

STUDY LOAD

Type	Hours	Percentage
Self study	102,0	68.00
Hours small group	36,0	24.00
Hours large group	12,0	8.00

Total learning time: 150 h

CONTENTS

Cleanroom facilities

Description:
1. Context: why do we need a cleanroom? Concept of contamination in microelectronics. Three levels of contamination reduction: cleanrooms, wafer cleaning, and gettering. Cleanroom classifications and standards.
2. Installations: Cleanroom design principles and environmental controls. Filtration, air contamination. Temperature, humidity, and overpressure control. Services: ultra-pure water, vacuum system, gas distribution.
3. Working in a cleanroom: Behaviour and prevention of occupational hazards. Safety protocols and contamination control measures. Wafer handling. Organization of production. Basic concepts of yield management and defect reduction strategies.
4. The clean room and its environment: Sustainability and environmental issues.

Full-or-part-time: 7h
Theory classes: 7h

Manufacturing

Description:
1. Introduction to the clean room (UPC or IMB-CNM): safety protocols/ locker room/ internal visit to different rooms/ + one/s small experiment/s (e.g. wafer cutting).
2. Basic processes I: wafer cleaning (RCA1/RCA2)/oxidation (UPC)
3. Basic Processes II: lithography/wet etching (UPC)
4. Basic Processes III: Diffusion/Deposition (ALD or sputtering or PECVD) (UPC)
5. Site visit (IMB-CNM)

Full-or-part-time: 25h
Laboratory classes: 25h

Introduction to external foundries

Description:
1. Introduction: Access to commercial technologies. IC suppliers.
2. Methodology: Searching for the best technology for our purposes: coarse description of the technology. Access to design kit files.
3. Examples: Some examples of technology parameters and design rules: fine description of the technology.

Full-or-part-time: 3h
Theory classes: 3h

Definition of a manufacturing process

Description:
1. Introduction to process integration: Definition of process integration. Brief review of technology processes. Concept of process blocks.
2. Project work: Definition of a device manufacturing process in groups of 3-4 students: sequence of steps; equipment and recipe type; mask design; definition of test structures

Full-or-part-time: 13h
Theory classes: 2h
Laboratory classes: 11h

GRADING SYSTEM

Course work (10%), mini-project (block 4 20%) plus exam (70%)

BIBLIOGRAPHY

Basic:
- Whyte, W. Cleanroom technology: fundamentals of design, testing and operation. 3rd ed. Independently published, 2023. ISBN 9798370511592.
- Xiao, H. Introduction to semiconductor manufacturing technology [on line]. 2nd ed. Bellingham, Wash.: SPIE, 2012 [Consultation: 14/06/2024]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1120176. ISBN 9780819490933.
- Ohring, M.; Gall, D.; Baker, S.P. Materials science of thin films [on line]. 2nd ed. Elsevier Science & Technology Books, 2002 [Consultation: 13/06/2024]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780125249751/materials-science-of-thin-films. ISBN 9780125249751.
- Quirk, M.; Serda, J. Semiconductor manufacturing technology. Upper Saddle River: Prentice Hall, 2001. ISBN 9780130815200.
- Wolf, S. Silicon processing for the VLSI era. Vol.2: process integration. Sunset Beach: Lattice, 1990. ISBN 0961672145.