Module Name: **Cleanroom Microfabrication**					
Module Responsibility / Lecturer	Assoc. Prof. Dr. Jakob Kjelstrup-Hansen				
Department, Facility	SDU, Faculty of Engineering, Mads Clausen Institute and NanoSYD				
Module Number		**Level**	Master	**Short Name**	
Course of Studies	Medical Microtechnology, Master				
Compulsory/elective	Compulsory	**ECTS Credit Points**	5		
Semester of Studies	2	**Semester Hours per Week**	4		
Length (semesters)	1	**Workload (hours)**	150		
Frequency	SuSe	**Presence Hours**	48		
Teaching Language	English	**Self-Study Hours**	102		
Consideration of Gender and Diversity Issues	☒ Use of gender-neutral language (THL standard)				
	☐ Target group specific adjustment of didactic methods				
	☐ Making subject diversity visible (female researchers, cultures etc.)				
Applicability	None				
Remarks	None				

Course 1: Cleanroom Microfabrication Lab			
Course Number		**Short Name**	
Course Type	Lecture and lab exercises	**Form of Learning**	Presence
Mandatory Attendance	☒	**ECTS Credit Points**	5
Participation Limit	None	**Semester Hours per Week**	4
Group Size (practical training, exercises, …)	n. a.	**Workload (hours)**	150

Teaching Language	English	**Presence Hours**	48
Study Achievements („Studienleistung“, SL)	None	**Self-Study Hours**	102
SL Length (minutes)	n. a.	**SL Grading System**	n. a.
Exam Type	Oral exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	7-scale grading
Learning Outcomes	Knowledge • The knowledge of the basics of a cleanroom, the working procedures, and the safety aspects. • The knowledge of the structure and properties of silicon and the reason for its large prevalence. • The knowledge of photolithography and of the steps in the photolithographic process. • The understanding of the process of formation of silicon dioxide by thermal oxidation. • The knowledge of the most commonly used chemical and physical vapor deposition techniques incl. their operation principles and of which types of materials that can be deposited. • The knowledge of the most commonly used wet and dry etching methods and their pros and cons. Skills • The ability to use a theoretical model to predict the resulting layer thickness of a silicon dioxide layer made by thermal oxidation. • The ability to experimentally carry out a simple process recipe using the most common microfabrication techniques.		
Participation Prerequisites	None		

Contents	The objective of this course is to make the students familiar with the concepts, materials and methods typically used in a microfabrication process. The specific topics are:
	• Cleanroom technology
	• Silicon
	  o Crystal structure
	  o Wafer types and properties (sizes, crystal orientations, doping type and concentration)
	• Growth and deposition of thin films
	  o Growth of silicon dioxide on silicon by thermal oxidation
	  o Deposition of thin films by chemical vapor deposition
	  o Deposition of thin films by physical vapor deposition
	• Photolithography for pattern definition
	• Etching
	  o Wet etching		

	○ Dry etching
Literature	• J. D. Plummer et al., *„Silicon VLSI Technology - Fundamentals, Practice, and Modeling“*, Prentice-Hall (Pearson), 2000. • S. Franssila, *„Introduction to Microfabrication“*, 2nd edition, Wiley, 2010.
Remarks	None