Module Name: **Nanofabrication Technology (elective)**					
Module Number		**Level**	Master	**Short Name**	
Module Responsibility	Prof. Dr. Morten Madsen				
Department, Facility	SDU, Mads Clausen Institute and NanoSYD				
Lecturers	Prof. Dr. Yogendra Kumar Mishra Prof. Dr. Morten Madsen				
Course of Studies	Medical Microtechnology, Master				
Compulsory/elective	Elective	**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: Nanofabrication Technology			
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)	Lab exercises	**Self-Study Hours**	102
SL Length (minutes)	n. a.	**SL Grading System**	7-point grading scale
Exam Type	Oral exam	**Exam Language**	English
Exam Length (minutes)	20	**Exam Grading System**	7-point grading scale
Learning Outcomes	Knowledge • The knowledge of the applications area that require the use of nanofabrication technology • The knowledge of electron beam lithography (EBL) and of the steps in an EBL process • The knowledge of the nanoimprint lithography and focused ion beam and their pros and cons • The knowledge of the working principle and pros and cons of the most common bottom-up patterning techniques. Skills • The ability to optimize the pattern/pattern writing in NIL and FIB to minimize the potential artefacts inherent with these techniques • The ability to design a dose pattern for EBL that includes proximity effect correction and fabricate a nanoscale pattern based on this design. Competences • The ability to select the relevant nanofabrication techniques for a given application • The ability to optimize process parameters in a systematic way • The ability to work independently with electron beam lithography processing.		
Participation Prerequisites	None		
Contents	In many applications, materials need to be structured on a nanoscopic scale. These include e.g. nanoelectronics, nanooptics, nanomechanics, nanofluidics etc. This is often accomplished using some form of nanolithography technique. The aim of this course, is to make the students able to design		

	and fabricate nanostructures using the most common nanofabrication techniques. The specific topics are:
	• Introduction to nanofabrication and related application areas
	  o Nanoelectronics
	  o Nanooptics
	  o Nanomechanics
	  o Nanofluidics
	• Top-down patterning techniques
	  o Electron beam lithography (incl. exercise designing and fabricating EBL pattern)
	  o Nanoimprint lithography (NIL)
	  o Focused ion beam (FIB)
	  o Nanostenciling
	• Bottom-up patterning techniques
	  o Nanosphere lithography
	  o Self-assembled monolayers
	  o Porous alumina templates
	  o Block co-polymer lithography

Literature	Will be provided during the lectures.
Remarks	None