Integration

Module Code	Workload	Credits	Semester	Frequency of Module	Duration
	180 hrs.	6	1	Only winter semester	1 Semester

1	Module Components	Teaching Language	Contact Hours	Self Study	Class Size
	a) Technology of µSystems +µElectronics	a) English	a) 67,5 hrs.	a) 112,5 hrs.	a) 24

2 Learning Outcomes

After successful completion of the module the students

Knowledge (1)
... should be able to list the most important lithography techniques
... should be able to name several thin film deposition techniques
... should be able to present content of lab work to other students
... should be aware of main steps for fabrication of miniaturized systems
... should identify etching techniques for defined structures
... should know clean basic room concepts and clean room quality parameters

Comprehension (2)
... are able to understand the difference between hybrid and monolithical integration
... are able to describe process details of processes made in the lab to the lecturer and other group members
... are able to select proper lithography parameters for given structure size

Application (3)
... are able to perform specific process steps by themselve
... are able to calculate process time for thermal oxidation
... are able to calculate resolution of a given lithography process
... are able to construct outcoming 3D structures for anisotropic etching of c-Si
... are able to outline and define modern processes for microtechnology with specific focus on Si-based technology
... are able to predict cost for simple microtechnology processes

Analysis (4)
... are able to deduce process a measurement errors from a given set of measurements
... are able to compare deposition quality of different thin film techniques
... are able to distinguish between etching techniques for 2D structuring and 3 D structuring
... are able to distinguish different techniques in respect to quality measures e.g. critical dimension control

Synthesis (5)
... are able to summarize the most important technology steps within microfabrication
... are able to prepare summarizing protocols of lab work

	Learning Outcomes **Evaluation (6)** ... are able to explain specific processes in microfabrication to lecturer and group members ... are able to choose proper parameters for specific processes in microfabrication
3	**Individual Component Content** a) I Introduction - Historical Trends in IC-technology and micromachining for MEMS/microsystems II Basic concepts in Si-technology - Deposition techniques (thin film technolo-gy), Doping and Diffusion, Lithogra-phy, Etching techno--logy (wet and dry) - Cleanroom concepts, costs and yield issues in Si-technology III Micromachining for MEMS/microsystems - Bulk micromachining (including electrochemical etching of c-Si), surface micromachin-ing, LIGA, Process integration aspects/ smart sensors IV New developments for micromedicine and application examples V Chemistry of Semiconductor Processes: - Materials and classifications - Hazardous Substances in Microelectronics Practical training: - Processes in cleanroom: Lithography, thin film deposition, Etching, Oxidation quality in microtechnology, packaging and bonding techniques - Process simulation with Suprem/Intellisuite
4	**Teaching Methods** a) Lecture / Practical
5	**Prerequisites** Physics, mathematics/calculus (differential equations, higher functions, integrals), material science of semiconductors

6	**Methods of Assessment** a) Graded Assessment 1K (Written Exam) (6 LP insgesamt für alle Teilprüfungsleistung dieser Lehrveranstaltung) a) Non Graded Assessment 1sbL (Laboratory)
7	**Applicability of Module** Smart Systems M.Sc. (SMA)
8	**Person Responsible for Module** Prof. Dr. Ulrich Mescheder (Module Responsible)
9	**Reading List (Core Texts and Recommended Texts)** a) Campbell, S. A., Lewerenz, H. J.: Semiconductor micromachining, Vol. 2, Technologies and Industrial Applications, Wiley & Sons 1998 Sze, S. M. 1936-: VLSI technology, [internat. ed.], 2. ed., McGraw-Hill 1988 Schumicki, Guenter; Seegebrecht, Peter: Prozeßtechnologie : Fertigungsverfahren für integrierte MOS-Schaltungen, Springer 1991 Mescheder, Ulrich: Mikrosystemtechnik : Konzepte und Anwendungen; mit 23 Tab., 2. , überarb. u. erg. Aufl., unveränd. Nachdr., Teubner 2010 Globisch, Sabine: Lehrbuch Mikrotechnologie für Ausbildung, Studium und Weiterbildung, Hanser Verlag 2011 (E-Book)