Components & Devices I

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) Sensors & Actors	a) English	a) 22,5 hrs.	a) 37,5 hrs.	a) 24
	b) Optoelectronics	b) English	b) 22,5 hrs.	b) 37,5 hrs.	b) 24
	c) Lab Components & Devices	c) English	c) 22,5 hrs.	c) 37,5 hrs.	c) 24

2 Learning Outcomes

After successful participation in the module the students can

Knowledge (1)
... describe optical basics (description of light and optical physics) and optoelectronics components as LED, Laser etc.
... describe the concepts for microsensors and microactors as most important examples of Microsystems
... describe the specic layout consideration of Si-based micromechanical sensors such as pressure sensors and accelerometers (piezoresistive effect, mechanical properties, capacitive sensing)

Comprehension (2)
... explain typical realization schemes and areas of microactors (advantages, disadvantages) Understand basic design rules for microactors
... explain the most important actuation principles for microactors (advantages, disadvantages)

Application (3)
... apply optical and optoelectronic components and sensors and actors

Analysis (4)
... calculate, analyse and simulate simple optical systems and complex optoelectronic circuits in theory and practical work as well
... analyse the design of optical systems and optoelectronics and sensors and actors

Synthesis (5)
... design and compose basic optoelectronic systems and sensor and actor oriented systems

Evaluation (6)
... do evaluation of optical systems and optoelectronic circuits and sensors & actors as well

3 Individual Component Content

a) Microsystems: denitions and applications, economical aspects materials for microsystems micromechanical sensors: piezoresistive pressure sensors, capacitive accelerometers, micromechanical gyros, new developments micro

actuators: actuation concepts, realization examples in fluidic systems, optics and mechanics integration concepts design and simulation of microsystems Using sensors and actors available on the market or from research work the students will do a project in groups. In this project the sensors and actors will be analysed and applied by means of circuits, signal conditioning, simulation and so on.

b) Introduction and Application Examples

Applications

Optics

- Electromagnetic Waves and light speed
- Light and its properties
- Laws of light
- Applications in optics

Optoelectronics

- Effects between Light and Electrical Devices
- Electronics to Light LED, Laser, Light Emission, …
- Light to Electronics Photodetectors, Photodiodes, LEDs,
- Coupling of optical wave guides
- Transmission of light and fiber optics
- Others

Specials

c) Experiments to the topics; students have to choose 5 experiments out of the list:

- Sensors & Actors

1. Microsystems Sensors for pressure, acceleration, gyroscopes, temperature
2. Signal conditioning by means of anologue and digital circuits
3. Interfaces for measurement & instrumentation

- Spectrometer

1. Photodiode
2. Reflection and Refraction
3. Gaussian Beams
4. NdYag Laser

- Experiments on Applications

1. Triangulation
2. Diffraction

	3. Laser Doppler Anemometer (LDA) 4. Michelson Interferometer 5. Absorption Spectroscopy 6. Fiber Bragg Grating 7. Fiber Communication 8. Error in Communication Systems 9. Wavelength Div. Multiplexing (WDM) 10. Wavelength Div. Demultiplexing (DWDM)
4	**Teaching Methods** a) Lecture b) Lecture c) Practical / Lab
5	**Prerequisites** Basic Knowledge in Physics (optics, semiconductors), Electrical Engineering (Electrical Theory)
6	**Methods of Assessment** a) Non Graded Assessment 1sbH (Written Elaboration) (1 LP) c) Non Graded Assessment 1sbL (Laboratory) (1 LP) Modulprüfung Components & Devices I 1K (Written Exam) (4 LP)
7	**Applicability of Module** Smart Systems M.Sc. (SMA)
8	**Person Responsible for Module** Prof. Dr. Robert Hoenl (Module Responsible) Prof. Dr. Ulrich Mescheder (Module Responsible) Dr. Volker Lange (Lecturer)

9 **Reading List (Core Texts and Recommended Texts)**

a) Mescheder, Ulrich: Mikrosystemtechnik : Konzepte und Anwendungen; mit 23 Tab., 2. , überarb. u. erg. Aufl., unveränd. Nachdr., Teubner 2010

Kovacs, Gregory T. A.: Micromachined transducers sourcebook, WCB McGraw-Hill 1998

Ristic, Ljubisa: Sensor technology and devices, Artech House 1994

Sze, S. M. 1936-: Semiconductor sensors, Wiley 1994

Menz, Furukawa: Micro Mechanical Systems, Vol. 6 of series, Handbook of Sensors and Actuators, Elsevier 1998

Bau, de Roij, Kloeck (vol. ed.): Mechanical Sensors, Vol. 7 of the Series/Sensors/(ed. Göpel, Hesse, Zemel), VCH 1994

Hönl R.: Lecture Sensoren für die Überwachungstechnik

b) Young H.D., Young R., Freedman A.: Sears and Zemasky´s university physics, publ. Pearson Education, Inc. San Francisco/USA(CA) 2004

Kühlke, Dietrich: Optik: Grundlagen und Anwendungen; mit Tabellen, Beispielen und Aufgaben mit Lösungen, 3. Auflage, Deutsch 2011

Born, Max; Wolf, Emil: Principles of optics : electromagnetic theory of propagation, interference and diffraction of light, 7. (expanded) ed., repr. with corr., Cambridge University Press 2002

Schröder, Gottfried; Treiber, Hanskarl: Technische Optik : Grundlagen und Anwendungen, 10., erw. Aufl., Vogel 2007

Schmidt W., Feustel O.: Optoelektronik, Vogel Business Media, Würzburg

Hönl R.: Lecture notes