TECHNISCHE HOCHSCHULE LÜBECK

Module: Microwaves

Level	Bachelor	**Short Name**	MW
Responsible Lecturers	Bartels – v. Mensenkampff, Stefan, Prof. Dr. – Ing.		
Department, Facility	Electrical Engineering and Computer Science		
Course of Studies	Allgemeine Elektrotechnik, Bachelor		
Compulsory/elective	Compulsory	**ECTS Credit Points**	5
Semester of Studies	6	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	SuSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Written Exam	**Exam Language**	English
Exam Length (minutes)	120	**Exam Grading System**	One-third Grades
Learning Outcomes	The students are able to design and analyze systems and subsystems for use in microwave communication. They can apply RF design techniques in the microwave frequency range using various specific microwave technologies such as microstrip, waveguide or waves in dielectric. They can design linear antennas as well as reflector- or horn-antennas for various purposes. They can design matching networks using lumped or distributed elements of various technologies. The students are familiar with microwave measurement equipment for various technologies and can operate this equipment properly. They can simulate, microwave components and systems on different levels such as analytic models or 3D-EM. They can design planar microwave components from specification, using simulation on different levels, prototyping measurement and documentation.		
Participation Prerequisites	Analog Electronics, Signals and Systems, Radio Frequencies		

The previous section is filled only if there is **exactly one** module-concluding exam.

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	Communications, Analog Electronics, Signals and Systems
Remarks	

TECHNISCHE HOCHSCHULE LÜBECK

Module Course: Microwaves (Lecture)

(of Module: Microwaves)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	3
Participation Limit		**Semester Hours per Week**	3
Group Size		**Workload (hours)**	90
Teaching Language	English	**Presence Hours**	45
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	45
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents

1. Introduction

2. Smith Chart
   - Fundamentals
   - Impedance Matching Network Design using smith Chart
     - Serial and Parallel L, C, R
     - Transmission Line Representation in Smith Chart
     - Q-Arcs (Bandwidth)
     - Change in Characteristic Impedance

3. S-Parameters

4. Antennas
   - Radiation / Plane Wave
   - Polarization
   - Antenna Parameters
     - Radiation Pattern
     - Directivity and Gain
     - Effective Aperture
     - Input Impedance
   - Power Transmission between Antennas
   - Hertzian Dipole
   - Radiation from Currents
     - Linear Antennas
     - Dipole Antennas
   - Radiation from Apertures

	• The Principle of Equivalence • Aperture Radiator Design • Horn Antennas • Parabolic Reflector Antennas 5. Wave Propagation in Different Media • Free space, Dielectric • Waveguide • Microstrip • Transmission Line Representation in Smith Chart 6. Components based on Transmission Lines (Distributed Elements) • Free Space • Quarterwave Transformer • Absorber • Waveguide • Quarterwave Transformer • Taper • Terminations • Reactances • Resonators • Directional Couplers • Microstrip • Quarterwave Transformers • Resonators • Reactances • Planar Antennas (Patch), • Stepped Impedance Filters • Couplers • Edge Coupled Filters • Interdigital Filters 7. Ferrite Components • Isolator • Circulator 8. Active Microwave Components • Travelling Wave Tube • Magnetron • Gunn Element • Transistors
Literature	• Worksheets from lecture (online) • Young, Electronic Communication Techniques, Prentice Hall 2003 • Pozar, David M. Microwave Engineering, Wiley and Sons Inc., 2005. • Meinke, Gundlach, Taschenbuch der Hochfrequenztechnik, Springer 2009
Remarks	

Module Course: Microwaves (Laboratory)

(of Module: Microwaves)

Course Type	Practical Training	**Form of Learning**	Presence
Mandatory Attendance	yes	**ECTS Credit Points**	2
Participation Limit		**Semester Hours per Week**	1
Group Size	10	**Workload (hours)**	60
Teaching Language	English	**Presence Hours**	15
Study Achievements ("Studienleistung", SL)	Practical Training	**Self-Study Hours**	45
SL Length (minutes)		**SL Grading System**	Pass

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	Experiment 1: Microwave Components and Measurements. Network Analysis Experiment 2: Microstrip Filters and Couplers (includes introduction to microwave CAD- Software) Experiment 3: Planar Microwave Antennas. Design and Measurement Experiment 4: RF-Amplifier and Transmission-Lines. Network Analysis and Matching Techniques
Literature	• Worksheets from lecture (online) • Labscripts (online) • Pozar, David M. Microwave Engineering, Wiley and Sons Inc., 2005.
Remarks	