Complete Catalogue of all modules FB 18 Electrical Engineering and Information Technology (PO 2023)

Module handbook FB 18 Date: 17.04.2026



TECHNISCHE UNIVERSITÄT DARMSTADT

FB 18

Module handbook: Complete Catalogue of all modules FB 18 Electrical Engineering and Information Technology (PO 2023)

Date: 17.04.2026

FB 18 Email: servicezentrum@etit.tu-darmstadt.de

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1.1 Lectures

Mo Svs	Module name System Dynamics and Automatic Control Systems II					
Module nr. Credit points Workload Self-study Module duration Module cycle						
18-	ad-1010	7 CP	210 h	135 h	1 Term	Summer term
Lan	iguage			Module owner	. 1	
Ger	man			Prof. DrIng. Jur	gen Adamy	
1	Teaching co Main topics	ontent covered are:				
	 Root locus method (construction and application), State space representation of linear systems (representation, time solution, controllability, observability, observer- based controller design) 					
2	Learning objectives After attending the module, a student is capable of:					
	 constructing and evaluating the root locus of given systems describing the concept and importance of the state space for linear systems defining controllability and observability for linear systems and being able to test given systems with respect to these properties stating controller design methods using the state space, and applying them to given systems applying the method of linearization to non-linear systems with respect to a given operating point 					
3	Recommend System Dyna	led prerequisites for amics and Control Sy	or participation or stems I			
4	Form of examination					
	• Module	e exam (Technical ex	amination, Exam	ination, Duration:	180 Min., Default RS)
5	Prerequisite for the award of credit points Passing the final module examination					
6	Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)					
7	Usability of the module B.Sc. etit, B.Sc. MEC, M.Sc. WI-etit, M.Sc. CE, M.Sc. MedTec, B.Ed. etit, B.Sc. und M.Sc. iST, B.Sc. WI-etit, M.Sc. etit - CMEE, M.Sc. etit - VAS					
8	Grade bonu	s compliant to §25	(2)			

9	References Adamy: Systeme	References Adamy: Systemdynamik und Regelungstechnik II, Shaker Verlag (available for purchase at the FG office)				
Cot	urses					
	Course nr.Course name18-ad-1010-vlSystem Dynamics and Automatic Control Systems II					
Instructor Prof. DrIng.		gen Adamy	Type Lecture	SWS 3		
	Course nr.Course name18-ad-1010-ueSystem Dynamics and Automatic Control Systems II					
	Instructor Prof. DrIng. Jür	Type Practice	SWS 2			

Mo Pro	dule name gramming in	Automatic Control (C/C++)				
Mo 18-	dule nr. ad-1020	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cyc Winter tern	c le n
Lar Ger	Language Module owner German Prof. DrIng. Rolf Findeisen						
1	Teaching content Makefiles, compiler, numeral systems and numeral representation, C programming: Structures in C (variables and types, functions and operators, structures and control loops), arrays and strings, pointer arithmetics, dynamic memory allocation, development environment and debugger; C ++: Concept of object-oriented programming, classes, operator overloading / function overwriting						
2	 Learning objectives Students can after successful completion of the module: assembling and using makefiles, working with different numeral systems and representations, understanding and applying standard C tools (variables, functions, operators, control structures, arrays, strings), explaining and implementing of pointers in C programming, defining the memory requirement of variables during the runtime of the program (dynamic memory allocation) explaining and using the concept of object oriented programming in C ++, working with abstract data types (classes). 						
3	Recommended prerequisites for participation						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 						
5	Prerequisite Passing the	e for the award of c final module examination	redit points ation				
6	Grading Module exan • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. CE,	B.Sc. MedTec, B.S	Sc. WI-etit			
8	Grade bonus compliant to §25 (2)						
9	9 References Lecture slides						
Coι	urses						
	Course nr. 18-ad-1020-	vl Programming	in Automatic Con	trol (C/C++)			
	Instructor Dr. Ing. Eric	Lenz			Type Lecture		SWS 1

	Course nr. 18-ad-1020-ue	Course name Programming in Automatic Control (C/C++)		
	Instructor Dr. Ing. Eric Lenz	Z	Type Practice	SWS 1

Mo	dule name					
Ele	ctrical Power	Engineering	x47 11 1	0.10 . 1		NG 1 1 1
MO	dule nr. bt-1010	Credit points	Workload	Self-study	Module duration	Summer term
Lat	001120E	0.01	100 11	Module owner	1 Ieim	buillier term
Gei	rman			Prof. DrIng. Yve	s Burkhardt	
1	Teaching co	ontent				
	The lecture general and such as the l First, the phy electromagn movement a Then, an ove impact, such of biomass d energy source due to nucle The increasin sources (dep The resulting section, ener thermal cycl thermionic of supply with generator to stability is a forms of ener	gives an introduction to the basic tasks and human metabolism a ysical basics of the ter etic, chemical and nu and electricity. erview of the energy as the solar heat and lue to solar radiation ces of nuclear fission ar effects in the Earth ng energy demand of posits, acreage, solar g energy flows on trans rgy conversion process es or hydraulic process converters are address respect to the increas o the consumer with addressed. The stora ergy will be discussed by are mentioned.	to the technical p d challenges of the re therefore not s m "energy" are rep aclear) are explain resources is given d the motion of ain a and the fossil en- (uranium deposit s interior are exp the rapidly growin radiation, wind n nsport routes such sees (direct and in- esses in power plan ssed. Afterwards, sing proportion of an overview of the age of energy and d. Finally, question	processes for the use electrical energy in ubject of the course reated and the different ed in terms of the to starting from the mass, surface wate ergy sources oil, na s) and nuclear fusion lained as well as the g world population haps, tidal currents as pipelines, water direct methods) are not sare discussed m a specialization tal the electric power erequired resource in particular of electric s for the contempor	se of energy for the h n particular. Biochem e. rent forms of energy (echnical use of energy solar radiation and it er and sea waves. Ner atural gas and coal w on (heavy water), an e tidal effects caused and the geographic of ,) are described. ways,, are briefly p e illustrated. Large-sc tainly, but also margin kes place on the subj applications. The ch ress, the hiring electri lectrical energy by co prary use of energy re	numan civilization in ical energy processes (mechanical, thermal, y as heat, mechanical ts direct and indirect xt, the energy source ill be discussed. The d geothermal energy by planetary motion. distribution of energy oresented. In another ale processes such as nal processes such as fect of electric power tain from the electric cal load flow and its onverting into other esources in regard to
2	Learning of Students kn Earth.	ojectives ow the physically bas	sed energy basics	and have an overv	iew of the energy res	sources of our planet
	They unders	stand the fundament	tal energy convers lectrical work	sion processes on t	he technical use of e	nergy in the form of
	They have ac to the consur They are ab for conversion systems, ene	cquired basic knowled mer and are able to ec le to perform basic c on and transportation ergy industry, and on	lge of electrical en lucate themselves calculations for er n losses. They are future forms of e	gineering in the cha about current issues nergy content, ener prepared for adva nergy supply.	ain of effects from ele s of energy use and its rgy conversion, effici nced lectures on ene	ectric power producer future development. encies, storage, and rgy components and
3	Recomment Basic knowl chemistry (b	ded prerequisites fo ledge of physics (me pinding energy) are c	or participation echanics, thermoo lesirable and facil	lynamics, electrica	l engineering, struc g of the energetic pro	ture of matter) and ocesses.
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	120 Min., Default RS	3)
5	Prerequisite Passing the	e for the award of c	redit points			
6	Grading					

	Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)					
	would exam (rechined examination, Examination, weighting, 100 76)					
7	Usability of the B.Sc. etit, B.Sc. I	module MEC, M.Sc. ESE, B.Sc. CE, B.Sc. und M.Sc. iST, B.Sc. WI-etit				
8	Grade bonus co At the beginning lecture that will	mpliant to §25 (2) of the semester, it will be announced whether there will be hor enable an improvement in grades.	nework tests accompany	ving the		
9	References Lecture notes (slides) Practice documents (examples, solutions) Additional and more detailed literature: • Grothe/Feldhusen: Dubbel-Taschenbuch für den Maschinenbau, Springer, Berlin, 2007, 22. Aufl.; besonders: Kapitel "Energietechnik und Wirtschaft" • Sterner/Stadler: Energiespeicher - Bedarf, Technologien, Integration, Springer-Vieweg, Berlin, 2011 • Rummich: Energiespeicher, expert-verlag, Renningen, 2015, 2. Aufl. • Strauß: Kraftwerkstechnik zur Nutzung fossiler, nuklearer und regenerativer Energiequellen, Springer, Berlin, 2006, 5. Aufl. • Hau: Windkraftanlagen -Grundlagen, Technik, Einsatz, Wirtschaftlichkeit, Springer-Vieweg, Berlin, 2014, 5. Aufl. • Heuck/Dettmann/Schulz: Elektrische Energieversorgung, Springer-Vieweg, Berlin, 2014, 9. Aufl. • Quaschning: Regenerative Energiesystem, Hanser, München, 2001, 7. Aufl.					
Co	ırses					
	Course nr. 18-bt-1010-vl	Course name Electrical Power Engineering		-		
	Instructor Prof. Dr. techn. I	Dr.h.c. Andreas Binder	Type Lecture	SWS 3		
	Course nr. 18-bt-1010-ue	Course name Electrical Power Engineering	1			

		•	•		
Instructor				Туре	SWS
Prof. Dr. techn. I	Dr.h.c. Andreas B	inder		Practice	1

Mo Eleo	dule name ctrical Machin	es and Drives				
Mo 18-	dule nr. bt-1020	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration 1 Term	Module cycle Winter term
Lar Ger	n guage man			Module owner Prof. DrIng. Yve	s Burkhardt	
1	1 Teaching content Construction and function of induction machine, synchronous machine, direct current machine. Electromagnetic field within machines, armature windings, steady-state performance as motor/generator, application as line-fed and inverter-fed drives. Significance for electric power generation, both to the grid and in stand-alone version.					
2	 2 Learning objectives Upon successful completion of the module, students will be able to: calculate and explain the stationary operation performance of the three basic types of electric machine sin motor and generator mode, understand the application of electrical machines in modern drive systems and to design simple drive applications by yourself, understand and explain the function and physical background of the components of electrical machines understand and explain the impact of basic electromagnetic field and force theory on the basic function of electrical machines. 					
3	Recomment Mathematics	ded prerequisites fo I to III, Electrical Eng	or participation gineering and Info	rmation Technolog	y I and II, Physics, Me	chanical Engineering
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	120 Min., Default RS	i)
5	Prerequisite Passing the f	e for the award of c final module examina	redit points ation			
6	Grading Module exar • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. etit, B. B.Sc. WI-etit	the module .Sc. MEC, M.Sc. ESE t	, M.Sc. etit - SAE	, M.Sc. etit - EET,	B.Sc. CE, B.Ed. etit,	B.Sc. und M.Sc. iST,
8	Grade bonu At the begins that will ena	is compliant to §25 ning of the semester, able an improvement	(2) it will be announce in grades.	ed whether there w	ill be short tests accor	mpanying the lecture
9	References					

- Detailed textbook and collection of exercices; Complete set of PowerPoint presentations
- A. Binder: El. Maschinen u. Antriebe: Grundlagen, Betriebsverhalten, Springer Vieweg, 2017
- A. Binder: El. Maschinen u. Antriebe: Übungsbuch, Springer Vieweg, 2017
- E. Bolte: Elektrische Maschinen, Springer Vieweg, 2018
- R. Fischer: Elektrische Maschinen, Carl Hanser Verlag, 2017
- J. Pyrhönen, T. Jokinen, V. Hrabovcova: Design of Rotating Electrical Machines, 2013, Wiley
- G. Müller, B. Ponick: El. Maschinen: 1: Grundlagen, 2014; 2: Berechnung, 2007, Wiley-VCH
- Th. Bödefeld, H. Sequenz: Elektrische Maschinen, Springer Vieweg, 1971
- H.-O. Seinsch: Grundlagen el. Maschinen u. Antriebe, Springer Vieweg, 1993

Courses

00	41303			
	Course nr.Course name18-bt-1020-vlElectrical Machines and Drives			
	Instructor Prof. DrIng. Yves Burkhardt		Type Lecture	SWS 2
	Course nr. 18-bt-1020-ue	Course name Electrical Machines and Drives		
	Instructor Prof. DrIng. Yves Burkhardt		Type Practice	SWS 2

Mo Fou	dule name ndations of P	recision Engineering						
Mo	dule nr. bu-1010	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module of 1 Term	duration	Module cyo Winter tern	cle n
Lan Ger	i guage man	I	I	Module owner Prof. Ph.D. Thom	as Burg			
1	1 Teaching content Precision engineering enables the repeatable integration of microelectronic and mechanical components with sensors and actuators to create dense and complex electromechanical systems. The applications range from mass products such as smartphones or cars to precision prototypes in medical technology, spaceflight, and scientific instrumentation. The course introduces the principles of design and manufacturing for precision with critical dimensions in the micrometer to millimeter range. Manufacturing methods including casting, molding, sintering, 3D printing, forming, cutting, etching, and joining will be explained. The properties, composition, and modifications of materials (metals and alloys, ceramics, polymers, composites) will be discussed in the context of key manufacturing processes.					nts with ge from ht, and on with nolding, on, and context		
2	 Learning objectives To be able to classify and explain the most important maufacturing technologies, and to critically assess their respective advantages and disadvantages. To select suitable manufacturing technologies and to design for their application. To make quantitative estimates of the limitations of a given process and to evaluate the potential of new developments based on your knowledge of physical principles and materials. 					ess their for their ential of		
3	Recommended prerequisites for participation							
4	Form of exa Module exam • Modul The examina less than 6 s will be anno	mination n: e exam (Technical ex ation takes place in fo tudents, the examina unced at the beginni	xamination, Oral/ orm of a written e ation will be an ora ing of the course.	written examinatio xam (duration: 90 al examination (du	n, Duratio minutes). ration: 30	n: 90 Min. If enrollm min.). The	, Default RS) ent is expecte type of exam	ed to be
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weighti	ng: 100 %)	
7	Usability of B.Sc. etit, M	the module Sc. MEC, B.Sc. CE, 1	M.Sc. MedTec, M.	Sc. iCE, B.Sc. und	M.Sc. iST			
8	Grade bonu	s compliant to §25	(2)					
9	References	es, Moodle course						
Coι	ırses							
	Course nr. 18-bu-1010-	vl Course name Technology of	Micro- and Precis	ion Engineering				
	Instructor Prof. Ph.D. 7	Thomas Burg				Type Lecture		SWS 2

Course nr.Course name18-bu-1010-ueFoundations of Precision Engineering			
Instructor Prof. Ph.D. Thom	as Burg	Type Practice	SWS 1
Course nr. 18-bu-1010-pr	Course name Foundations of Precision Engineering Lab		
Instructor Prof. Ph.D. Thom	as Burg	Type Lab	SWS 1

Mo	dule name	medical Engineering				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	bu-1030	4 CP	120 h	75 h	1 Term	Summer term
Lar Ger	iguage man			Module owner Prof. Ph.D. Thom	as Burg	
1	 Teaching content Statics: force, moment, principle of section, equilibrium, center of gravity, truss, beam, adhesion and friction, levers. Elastomechanics: Stress and deformation, tension, torsion, bending. Kinematics: point and rigid body motion, forward kinematics Inverse kinematics. Kinetics: forces and moments theorem, energy and work, linear oscillators, momentum and twist theorem, impact. Biomechanics: mechanical properties of muscles, tendons; muscle-tendon dynamics in selected motion tasks (e.g., jumping, walking, running), inherent dynamics of human gait. Bioinspired robotics: fundamentals of mechanical design and dynamics of engineered systems (e.g., walking robot and assistance system). 					
2	2 Learning objectives Upon successful completion of the module, students will have learned the basic concepts of engineering me- chanics. They will be able to analyze simple statically determinate plane systems of statics, perform elementary elastomechanics calculations of statically determinate and statically indeterminate structures, describe and analyze motion processes, and solve plane motion problems, vibration and impact phenomena using the laws of kinetics. Students have learned to describe human motion mechanically and to derive dynamic models for motion analysis and synthesis and to transfer these to technical applications (e.g. walking robotics, prosthetics					
3	Recomment	ded prerequisites fo	r participation			
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the	e for the award of c r final module examina	redit points			
6	 Grading Module exam: Module exam (Technical examination, Examination, Weighting: 100 %) 					
7	Usability of B.Sc. MedTe	the module				
8	Grade bonu	s compliant to §25	(2)			
9	References					

• Markert, Norrick: Einführung in die Technische Mechanik, ISBN 978-3-8440-3228-4 The practice exercises are included in this book. Further reading:

- Markert: Statik Aufgaben, Übungs- und Pr
 üfungsaufgaben mit Lösungen, ISBN 978-3-8440-3279-6
- Markert: Elastomechanik Aufgaben, Übungs- und Prüfungsaufgaben mit Lösungen, ISBN 978-3-84403280-2
- Markert: Dynamik Aufgaben, Übungs- und Prüfungsaufgaben mit Lösungen, ISBN 978-3-8440-2200-1 Gross, Hauger, Schröder, Wall: Technische Mechanik 1 - 3. Springer-Verlag Berlin (2012-2014).
- Hagedorn: Technische Mechanik, Band 1 3. Verlag Harri Deutsch Frankfurt.
- Enoka: Neuromechanics of Human Movement
- McMahon: Muscle, Reflexes and Locomotion
- Sharbafi & Seyfarth: Bioinspired Legged Locomotion
- Spong, Hutchinson, Vidyasagar: Robot Dynamics and Control

Courses

CO	11565			
	Course nr.Course name18-bu-1030-vlMechanics in Biomedical Engineering			
	Instructor Prof. Ph.D. Thomas Burg		Type Lecture	SWS 2
	Course nr. 18-bu-1030-ue	Course name Mechanics in Biomedical Engineering		
	Instructor Prof. Ph.D. Thom	nas Burg	Type Practice	SWS 1

Mo Inti	dule name	ectrodynamics					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
Lar Ger	nguage man	0.01	100 11	Module owner Prof. DrIng. Her	bert De Gersem	buillier te	1111
1	1 Teaching content Vector calculus, orthogonal coordinate systems, Maxwell's equations, interface and boundary conditions, layered media, electrostatics, scalar potential, Coulomb integral, separation of variables, method of image charges, magnetostatics, vector potential, Biot-Savart law, stationary current fields, fields in matter, energy flow, skin effect, plane waves, polarization, TEM waves, reflection and multi-layer problems, multi conductor transmission lines (anactinance, inductance, and conductance matrix), valority definitions, basics of rootangular wavesquides.						
2	 2 Learning objectives Students will be familiar with Maxwell's equations in integral and differential form for static and dynamic field problems. They will have a mental picture of wave phenomena in free space. They are able to recognice and interpret wave effects in the different areas of electrical engineering. They are able to derive the wave effects from Maxwell's equations and have a good understanding of the necessary mathematical tools. 						
3	Recommended prerequisites for participation Lecture notes. Further literature recommendations are given in the course.						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 						
5	Prerequisite Passing the fi	for the award of c	redit points ation				
6	Grading Module exam • Module	: exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of t B.Sc. etit, B.S	he module c. MEC, B.Sc. CE, F	3.Ed. etit, B.Sc. ur	nd M.Sc. iST, B.Sc.	WI-etit		
8	Grade bonus Improvement	compliant to §25 by up to 0.4 due to	(2) bonus points wh	ich can be acquired	l by means of e-learn	ing online te	sts.
9	References Lecture notes	. Further literature	recommendations	s are given in the c	ourse.		
Coi	ırses						
	Course nr. 18-dg-1010-v	Course name Introduction to	o Electrodynamics	i			
	Instructor Prof. DrIng.	Herbert De Gersem	L		Type Lecture		SWS 2
	Course nr. 18-dg-1010-u	e Introduction to	o Electrodynamics				
	Instructor Prof. DrIng.	Herbert De Gersem			Type Practice		SWS 2

Course nr. 18-dg-1010-tt	Course name Introduction to Electrodynamics		
Instructor Prof. DrIng. Her	bert De Gersem	Type Tutorial	SWS 1

Mo Fin	dule name	Technique						
Mo 18-	dule nr. dg-1030	Credit points 3 CP	Workload 90 h	Self-studyModule durationModule cycle60 h1 TermSummer term				
Lar Ger	nguage man			Module owner Prof. DrIng. Her	rbert De Gersem			
1	1 Teaching content Basics FIT, electrostatics, magnetostatics, magnetoquasistatics, high frequency simulations, convergence studies, discretisation, time- and frequency domain simulations.					studies,		
2	2 Learning objectives Students learn the basic concepts of the Finite Integration Technique (FIT) for the numerical solution of Maxwell's equations. Students are, furthermore, introduced to the practical application of the method for numerical field problems.							
3	Recommended prerequisites for participation Basics of Maxwell's equations, linear algebra. Recommended: Basic knowledge in knowledge in "Technical Electrodynamics"							
4	Form of exa Module exar • Module	mination n: e exam (Technical e	xamination, Oral e	examination, Durat	tion: 30 Min., Defaul	t RS)		
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical e	xamination, Oral e	examination, Weigl	hting: 100 %)			
7	Usability of B.Sc. etit, B.	the module Sc. CE, M.Sc. iCE, N	I.Sc. etit - CMEE					
8	Grade bonu	s compliant to §25	(2)					
9	References Course notes	, lecture slides.						
Coi	urses							
	Course nr. 18-dg-1030-	Course namevlFinite Integrat	tion Technique					
	InstructorTypeSWSDrIng. Wolfgang AckermannLecture2					SWS 2		

Мо	dule name						
App	olications of El	ectrodynamics					
Mo	dule nr. dg-1040	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration	Summer te	cle rm
Lar Ger	Language Module owner German Prof. DrIng. Herbert De Gersem						
1	1 Teaching content Vector calculus, Maxwell's equations, electrostatics, magnetostatics, fields of stationary currents, electromagnetic waves and ultrasonic waves, analytical and numerical calculation techniques, wave propagation, reflection and transmission, diffraction, interference and polarization, applications of electromagnetic and ultrasonic waves in medical technology.					agnetic ion and vaves in	
2	2 Learning objectives The students get knowledge and intuition on electromagnetic fields and wave propagation phenomena. They are able to recognize and calculate field and wave phenomena in an electrical engineering context. They are familiar with the required mathematical tools. The students have a feeling for the application of electromagnetic fields and waves in medical engineering						a. They 'hey are 1agnetic
3	Recommend "Elektrotechn (04-00-0111)	ed prerequisites for ik und Informations	or participation technik II" (18-gt-	1020), "Mathemati	cs II" (04-00-0109), a	und "Mathema	atics III"
4	Form of exam Module exam • Module	nination n: e exam (Technical ez	xamination, Exam	ination, Duration:	120 Min., Default RS	5)	
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. MedTee	the module					
8	Grade bonus	s compliant to §25	(2)				
9	References Lecture slide	s can be downloade	d. Further referen	ices will be given ir	1 the lecture.		
Coι	ırses	1					
	Course nr. 18-dg-1040-v	Course namevlApplications o	f Electrodynamics				
	Instructor Prof. DrIng.	Herbert De Gersem	l		Type Lecture		SWS 2
	Course nr. 18-dg-1040-ι	Course name Applications o	f Electrodynamics				
	InstructorTypeSWSProf. DrIng. Herbert De GersemPractice2						

Mo Tec	dule name hnical Electro	dvnamics					
Mo 18-	dule nr. dg-1070	Credit points 6 CP	Workload 180 h	Self-study 105 h	Module duration	Module cy Winter terr	cle n
Lar Gei	iguage rman		I	Module owner Prof. DrIng. Her	bert De Gersem	1	
1	Teaching co Fields in ma mal mappin waveguides,	ntent terials, Green's func g, elliptic integrals a resonators, antenna	ctions, separation and elliptic functions.	of variables in ger ons, electromagnet	eralized orthogonal ic forces, quasi-statio	coordinates, onary fields,	confor- general
2	Learning of Starting with phenomena ability to de	ojectives h Maxwell´s equatio . Students will be ab al with more comple	ns the lecture´s a ble to apply analy x electromagnetic	im is to provide a g tical methods to sin formulations and	general understandin mple problems. Stud tasks.	g of electrom lents will exh	agnetic ibit the
3	Recomment Vector analy namics"	led prerequisites fo sis, infinitesimal calc	or participation culus, basics in diff	ferential equations.	Knowledge of "Intro	duction to Ele	ectrody-
4	Form of exa Module exar • Modul	mination n: e exam (Technical ez	xamination, Exam	ination, Duration:	180 Min., Default RS	5)	
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exar • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. etit, M	the module .Sc. WI-etit, M.Sc. C	E, B.Sc. WI-etit, N	И.Sc. etit - CMEE			
8	Grade bonu	s compliant to §25	(2)				
9	References Course notes	s available (including	g references)				
Co	urses		-				
	Course nr. 18-dg-1070-	vl Technical Elec	trodynamics				
	Instructor Prof. DrIng	. Herbert De Gersem	, DrIng. Wolfgar	ng Ackermann	Type Lecture		SWS 2
	Course nr. 18-dg-1070-	ue Technical Elec	trodynamics		i		
	Instructor Prof. DrIng	. Herbert De Gersem	, DrIng. Wolfgar	ng Ackermann	Type Practice		SWS 2
	Course nr. 18-dg-1070-	Course name tt Technical Elec	trodynamics				
	Instructor Prof. DrIng	. Herbert De Gersem	ı, DrIng. Wolfgar	ng Ackermann	Type Tutorial		SWS 1

Мо	dule name						
Inti	oduction to Pl	ysical Modelling		I	Γ	1	
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	ag-1080	6 CP	180 h	120 h	1 Ierm	Summer te	rm
Ger	man			Prof. DrIng. Her	bert De Gersem		
1	Teaching co	ntent		1			
	 Physical modelling: Principles Classification of physical model types (system, network, field models) Type classification of physical models (elliptic, parabolic, hyperbolic) + Examples from electrical engineering and mechanics Formulations, continuity equation, energy conservation, variational formulation, multiphysics settings Computer Aided Design and Computer Aided Engineering: Approach and workflow Modelling of engineering problems, modelling assumptions and errors Mathematical modeling: discretization errors, algorithmic errors Definition of quantities of interest, postprocessing Design and optimization 						
2	Learning ob The students it into a mat	jectives learn to formulate a nematical model.	n electrical engine	eering design task a	a physical problem	, and then to	transfer
3	Recommend Electrical En I/II/III, Stati	ed prerequisites for gineering and Infor stics/Probability Th	or participation mation Technologeory, Scientific Co	gy I/II, Introductio mputing, Physics	n to data-based mo	deling, Mathe	ematics
4	Form of exam Module exam • Module	mination a: e exam (Technical ex	xamination, Oral e	examination, Durat	ion: 30 Min., Defaul	t RS)	
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation				
6	Grading Module exan • Module	ı: e exam (Technical ez	xamination, Oral 6	examination, Weigh	nting: 100 %)		
7	Usability of B.Sc. etit, B.S	t he module Sc. CE, B.Sc. WI-etit	:				
8	Grade bonus	s compliant to §25	(2)				
9	References						
Coi	ırses						
	Course nr. $18 - d\sigma - 1080$	Course name	D Physical Modelli	nα			
	Instructor			115	Type		SWS
	Prof. DrIng.	Herbert De Gersem	L		Lecture		2

	Course nr. 18-dg-1080-ue	Course name Introduction to Physical Modelling		
Instructor		bert De Gersem	Type	SWS
Prof. DrIng. Her			Practice	1
	Course nr. 18-dg-1080-pr	Course name Introduction to Physical Modelling		
	Instructor		Type	SWS
	Prof. DrIng. Herbert De Gersem		Lab	1

Mo Svs	dule name tem Dynamics	s and Automatic Con	trol Systems I			
Module nr.Credit pointsWorkloadSelf-studyModule durationModule cyc18-fi-10106 CP180 h120 h1 TermWinter term				Module cycle Winter term		
Lan Ger	nguage man		100 11	Module owner Prof. DrIng. Roli	f Findeisen	
1	1 Teaching content Description and classification of dynamic systems; Linearization around an equilibrium point; Stability dynamic systems; Frequency response; Linear time-invariant closed-loop systems; Controller design; Controller design				n point; Stability of oller design; Control	
2	Learning of Students wi dynamic beh invariant sys	bjectives Il know how to descr aviour in time and fr stems.	ribe and classify c equency domain.	lifferent dynamic s The students will b	ystems. They will be e able to design contr	e able to analyse the rollers for linear time
3	Recommend	ded prerequisites fo	r participation			
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 				5)	
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exa • Modul	n: e exam (Technical ex	amination, Exam	ination, Weighting:	: 100 %)	
7	Usability of B.Sc. etit, B. - CMEE	the module Sc. MEC, M.Sc. CE, E	B.Sc. MedTec, B.Sc	e. CE, B.Ed. etit, B.S	Sc. und M.Sc. iST, B.S	Sc. WI-etit, M.Sc. etit
8	Grade bonu	s compliant to §25	(2)			
9	References					
	 Skript Konigorski: "Systemdynamik und Regelungstechnik I", Aufgabensammlung zur Vorlesung, Lunze: "Regelungstechnik 1: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen", Föllinger: "Regelungstechnik: Einführung in die Methoden und ihre Anwendungen", Unbehauen: "Regelungstechnik I:Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regelsysteme, Fuzzy-Regelsysteme", Föllinger: "Laplace-, Fourier- und z-Transformation", Jörgl: "Repetitorium Regelungstechnik", Merz, Jaschke: "Grundkurs der Regelungstechnik: Einführung in die praktischen und theoretischen Methoden", Horn, Dourdoumas: "Rechnergestützter Entwurf zeitkontinuierlicher und zeitdiskreter Regelkreise", Schneider: "Regelungstechnik für Maschinenbauer", Weinmann: "Regelungen. Analyse und technischer Entwurf: Band 1: Systemtechnik linearer und lin- earisierter Regelungen auf anwendungsnaher Grundlage" 					
Coι	ırses					

Course nr. 18-fi-1010-vl	Course name System Dynamics and Automatic Control Systems I			
Instructor Prof. DrIng. Rol	f Findeisen, M.Sc. Florian Weigand, M.Sc. Roland Schurig	Type Lecture	SWS 3	
Course nr. 18-fi-1010-tt	ourse nr.Course name8-fi-1010-ttSystem Dynamics and Automatic Control Systems I- Auditorium Exercise			
Instructor Prof. DrIng. Rol	f Findeisen, M.Sc. Florian Weigand, M.Sc. Roland Schurig	Type Tutorial	SWS 1	

Mo Prii	dule name	ics for Medical Engin	eering			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Isin-1010 O Cr 180 in 120 in 1 fermi winter term Language Module owner German Prof. Dr. habil. Torsten Frosch			winter term			
1	1 Teaching content Recapitulation of electromagnetic waves, electromagnetic and polarization optics, ray optics, optical system wave optics, interference, diffraction, Fourier optics, optical waveguides and fibers, photon optics, photon-atom interactions, introduction to light-matter interactions, atomic and molecular structure, absorption, scatterin fluorescence, resonator optics, lasers, photodetectors, principles of laser spectroscopy.					
2	2 Learning objectives Students will learn the fundamental of optics and optical systems. At the end of the course, students will understand the basics of light-matter interactions and on this basis the working principles of lasers and of some spectroscopic techniques. Using this knowledge, they will be able to understand common methods and instruments used in optical medical engineering. This module is intended as introduction for subsequent lectures on optical medical engineering.					ourse, students will ples of lasers and of mmon methods and r subsequent lectures
3	Recommen Mathematic	ded prerequisites for s I and II for electrica	r participation d engineering, phy	ysics for electrical e	engineering	
4	Form of exa Module exam • Modul The examin less than 20 examination	amination m: e exam (Technical ex ation takes place in students register, th a will be announced i	amination, Oral/ form of a writter le examination wi n the beginning o	written examinatio n exam (duration: ill be an oral exam f the lecture.	n, Duration: 120 Mir 120 minutes). If or ination (duration: 30	n., Default RS) ne can estimate that 0 min.). The type of
5	Prerequisit Passing the	e for the award of c final module examina	redit points			
6	Grading Module exa • Modul	m: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of M.Sc. CE, B	the module .Sc. MedTec				
8	Grade bonu	is compliant to §25	(2)			
9	References					
	 Bahaa E. A. Saleh und Malvin Carl Teich, Optik und Photonik, Wiley Eugen Hecht, Optik, Oldenburg Verlag Frank L. Pedrotti, Leno S. Pedrotti, Werner Bausch, Hartmut Schmidt, Optik für Ingenieure, Springer Herman Haken, Hans Christoph Wolf, Atom- und Quantenphysik, Springer Herman Haken, Hans Christoph Wolf, Molekülphysik und Quantenchemie, Springer Peter W. Atkins, Julio de Paula, Michael Bär, Physikalische Chemie, Wiley Wolfgang Demtröder, Laserspektroskopie 1&2, Springer 					
Co	Courses					

	Course nr. 18-fr-1010-iv	Course name Principles of optics for medical engineering		
Instructor	Instructor	orsten Frosch	Type	SWS
Prof. Dr. habil. 7	Prof. Dr. habil. To		Integrated course	4

Mo Pov	Module name Power Electronics						
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	gt-1010	5 CP	150 h	90 h	1 Term	Winter term	
Lan Ger	i guage man			Module owner Prof. DrIng. Ger	d Griepentrog		
1 Teaching content Power electronic devices convert the energy from the distribution network to the form required by the load. The conversion does not wear out, can be controlled very fast and has a high efficiency. In lecture "Power Electronic the most important circuits required for the energy conversion are treated, using ideal switches. The main chapters are I.) Line commutated converters in order to understand the basic concepts of power electronic systems. II.) Self- commutated converters (one two and four quadrant converters 3-phase- VSI)					red by the load. This e "Power Electronics" itches. onic systems.		
2	 2 Learning objectives The module teaches students after successful completion: Understand the ideal concept of power semiconductors Calculate and sketch the time-characteristics of all currents and voltages in a line-commutated converter using defined simplifications as well as represent the behavior of currents and voltages during commutation in line-commutated converters for center -tapped as well as for bridge circuits. Specify the basic circuit diagrams for one, two and four quadrant DC/DC converters and calculate the characteristics of voltages and currents in these circuits. Explain the function of single-phase and three-phase voltage source inverters and calculate the currents and voltages in these circuits using defined simplifications. Understand the concept und operation of HVDC converter 					mmutated converter during commutation ers and calculate the alculate the currents	
3	Recomment Mathe I und	ded prerequisites fo II, ETiT I und II, Ene	or participation ergietechnik				
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	amination, Exam	ination, Duration:	90 Min., Default RS)		
5	Prerequisite Passing the f	e for the award of c final module examina	redit points ation				
6	 6 Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %) 						
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. etit	- EET, M.Sc. etit -	AUT, B.Sc. CE, B.E	d. etit, B.Sc. und M.S	Sc. iST, B.Sc. WI-etit	
8	Grade bonu	s compliant to §25	(2)				
9	References						

Lecture notes, instructions for exercises are available for download in Moodle. Literature:

- Probst U.: "Leistungselektronik für Bachelors: Grundlagen und praktische Anwendungen", Carl Hanser Verlag GmbH & Co. KG, 2011
- Jäger, R.: "Leistungselektronik: Grundlagen und Anwendungen", VDE-Verlag; Auflage 2011
- Heumann, K.: "Grundlagen der Leistungselektronik"; Teubner; Stuttgart; 1985
- Lappe, R.: "Leistungselektronik"; Springer-Verlag; 1988
- Mohan, Undeland, Robbins: Power Electronics: Converters, Applications and Design; John Wiley Verlag; New York; 2003

Courses

CO	uises			
	Course nr. 18-gt-1010-vl	Course name Power Electronics		
	Instructor M.Sc. Lars Drese	Type Lecture	SWS 2	
	Course nr. 18-gt-1010-ue	Course name Power Electronics		
	Instructor M.Sc. Milad Kha	ni, M.Sc. Lars Dresel, Prof. DrIng. Gerd Griepentrog	Type Practice	SWS 2

Mo Ele	dule name ctrical Engine	ering and Informatio	n Technology II			
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	gt-1020	7 CP	210 h	135 h	1 Term	Summer term
Lar Ger	Language Module owner German Prof. DrIng. Gerd Griepentrog					
1	Teaching co Electrostation fields; capac	o ntent c fields; stationary el citor networks, transr	ectrical flow field nission lines	s; stationary magn	etic fields; temporal	ly variable magnetic
2	Learning of Upon succes all electrical plots and al divergence a a mathemat symmetric a quasi-static, of electricity apply it to si capacity and of the respe each other a the underly them mathe with the sys Maxwell's ec of electroma	bjectives ssful completion of t l procedures are line- lso design simple fie field, can describe the tical description, resp rrangements analytic the magnetostatic and y and magnetism; they imple examples; they l resistance of simple extive arrangement; the and are thereby alreating physical backgrou- ematically, develop in the of Maxwell's equipulations for all conce- agnetic waves in the final sectors of the final sectors of the and are thereby and the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of the sectors of t	he module the stu- bound; they have eld plots themselv- nis difference mat bectively; they are ally; they can dea id the magneto-ele ey control the mat can calculate wit geometrical arrang hey have recogni dy able to solve si unds for many ap t further in a sim uations in their in ptual formulations ree space and on	idents have detach e a clear idea of th ves; they understa thematically and a e able to calculate l surely with the de ectric field; they hav hematical apparatu h nonlinear magne gements and under zed, how different mple scientific eng plications of electr ple way and apply tegral representations of electrical engin transmission lines	hed themselves from e field term, can rea- nd the difference be re able to recognize field distributions for finitions of the electron we recognized the cor us necessary for their tic circuits; they can stand them now as pla forms of energy car ineering problems; th ical engineering and v it to other example ion have a first idea of eering. They underst for both harmonic an	the conception that d and interpret field etween a curl and a e the field type from r simple rotationally ostatic, the electrical mection and dualism r description and can compute inductance, hysical characteristics n be transferred into hey have understood are able to describe es; they are familiar of the importance of rand the propagation as transient signals.
3	Recomment Electrical Er	ded prerequisites fon rigineering and Inform	or participation nation Technology	7 I		
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	120 Min., Default RS	3)
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exame • Module	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. etit, B.	t he module .Sc. MEC, B.Sc. Med	Tec, B.Sc. CE, B.S	c. iST, B.Ed. etit, B	.Sc. WI-etit	
8	Grade bonu Notenverbes	as compliant to §25 sserung entsprechend	(2) l 25 (2) APB TU D	Darmstadt		
9	References					
- Downloadable slides
- Clausert, Wiesemann, Hinrichsen, Stenzel: "Grundgebiete der Elektrotechnik I und II"; ISBN 978-3-486-59719-6
- Prechtl, A.: "Vorlesungen über die Grundlagen der Elektrotechnik Band 2" ISBN: 978-3-211-72455-2

Courses

Co	urses			
	Course nr. 18-gt-1020-vl	Course name Electrical Engineering and Information Technology II		
	Instructor Prof. DrIng. Gen	rd Griepentrog	Type Lecture	SWS 3
	Course nr. 18-gt-1020-ue	Course name Electrical Engineering and Information Technology II		
	Instructor M.Sc. Daniel Gro	ßmann, Prof. DrIng. Gerd Griepentrog	Type Practice	SWS 2

Mo Me	dule name dical Systems					
Mo	dule nr. ha-1010	Credit points	Workload 90 h	Self-study 60 h	Module duration	Module cycle
Lar Ger	nguage man			Module owner Prof. DrIng. Chr	istoph Hoog Antink	
1	1 Teaching content The human body, diseases and therapy from an engineering perspective:Systems theory view & modeling of physiological processes • Disease as disturbed control circuits, therapy as restoration of disturbed control circuits • Circulation and blood pressure in equivalent circuits and control loops • Biopotentials: origin, measurement, signal processing and classification • Bioimpedance analysis, bioimpedance spectroscopy, electrical impedance tomography • Effects of electrical current on biological tissue & electrical safety • Modeling of the lung & lung function diagnostics • Physiological temperature control and heat therapy • Organ replacement therapy (diabetes, cardiac support systems)					
2	2 Learning objectives Students will have the ability to use fundamental engineering skills learned in other classes to understand healthy and diseased physiological processes as well as diagnosis and therapy. Students will be able to understand the basic principles of human anatomy and physiology using equivalent circuit diagrams and models. Students will know the effect of electric current on biological tissue and the basics of protection mechanisms. They know the basics of biopotential acquisition and bioimpedance measurement techniques. Through in-depth training in the field of electromedicine, students gain knowledge of the development of medical measurement and instrumentation technology. In addition, they master basic skills to apply control engineering methods to					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exam • Modul The examina 20 students will be anno	amination m: le exam (Technical ex ation takes place in fo register, the examina punced in the beginni	xamination, Oral/ orm of a written ex ition will be an ora ing of the lecture.	written examinatio am (duration: 90 n al examination (dui	n, Duration: 90 Min. hinutes). If one can es ration: 20 min.). The	., Default RS) stimate that less than type of examination
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of B.Sc. MedTe	the module ec, B.Sc. CE				
8	Grade bonu	is compliant to §25	(2)			
9	References					

- Leonhardt, Steffen, and Marian Walter, eds. Medizintechnische Systeme: Physiologische Grundlagen, Gerätetechnik und automatisierte Therapieführung. Springer-Verlag, 2016. (in German, available as free eBook from within the TU-network)
- Silbernagl, Stefan, and Agamemnon Despopoulos. Taschenatlas Physiologie. Georg Thieme Verlag, 2007. (in German)

Co	Courses						
	Course nr. 18-ha-1010-vl	Course name Medical Systems					
	Instructor Prof. DrIng. Chr	istoph Hoog Antink	Type Lecture	SWS 2			

Mo Cor	dule name	ns I					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle rm
Lar Ger	nguage man	0.01	100 11	Module owner Prof. DrIng. Chr	istian Hochberger	builliner te	
1	1 Teaching content Types of instruction sets, memory organization and its impact on the runtime, pipelining, instruction level parallelism, superscalar processors, VLIW processors, floating point numbers and operations, memory subsystem, cache types, virtual address spaces, benchmarking and performance prediction, system architecture and bus systems, peripheral devices					on level osystem, and bus	
2	2 Learning objectives Upon successful completion of the module, students can analyze and evaluate processors, memory systems and bus systems. They can transform structures of high-level programming languages like subroutine calls into sequences of machine instructions. They are able to measure the performance of computers. They know how instructions are executed in modern processors and thus, they can predict the influence of a specific memory hierarchy onto the execution time of a given program. They know how internal and external bus systems work and can define the essential parameters for their dimension and operation.						
3	Recommen Basic knowl	ded prerequisites fo edge of digital design	or participation n as it can be obta	ined by the lecture	"Logic Design".		
4	Form of exa Module exa • Modul	amination m: e exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., Default RS)	1	
5	Prerequisit Passing the	e for the award of c final module examin	redit points ation				
6	Grading Module exa • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. etit, B	the module Sc. MEC, M.Sc. WI-0	etit, M.Sc. etit - Al	UT, B.Sc. CE, B.Sc.	iST, B.Ed. etit, B.Sc.	WI-etit	
8	Grade bonu	is compliant to §25	(2)				
9	 9 References Harris & Harris: Digital Design and Computer Architecture Hennessy/Patterson: Computer architecture - a quantitative approach 						
Co	urses						
	Course nr. 18-hb-1020-	-vl Computer Sys	tems I				
	Instructor Type SWS Prof. DrIng. Christian Hochberger Jecture 3						

Course nr. 18-hb-1020-ue	Course name Computer Systems I		
Instructor Prof. DrIng. Chr	ristian Hochberger	Type Practice	SWS 1

Mo Elec	dule name ctronics							
Mo	dule nr. ho-1010	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module of 1 Term	luration	Module cyc Winter tern	c le n
Lan Ger	iguage man	1	I	Module owner Prof. DrIng. Kla	us Hofman	n		
1	Teaching co Semiconduc Analog Circu SPICE, Smal Digital Circu	ontent tor Devices: Diode, M uits: Basic Properties Il Signal Gain, Single uits: CMOS Logic Cir	MOSFET, Bipolar T , Properties and A Stage Amplifiers; cuits	Fransistor; Design of pplication of Opera Frequency Respon	of Electroni tional Amp se;	ic Circuits; blifiers, Cir	cuit Simulatio	on with
2	 2 Learning objectives A student is, after successful completion of this module, able to analyse Diodes, MOS- und Bipolartransistors in simple circuits calculate the properties of single transistor circuits, such as small signal gain, input and output resistance design inverting and non-inverting amplifiers from operational amplifiers and knows their ideal and non-ideal properties calculate the frequency behavior of simple transistor circuits distinguish the different methods to construct a logical gate from basic transistors and explain their fundamental properties. 							
3	Recomment Basics of Ele	ded prerequisites for ectrical Engineering	or participation					
4	Form of exa Module exa • Modul	amination m: le exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., D	efault RS)		
5	Prerequisit Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	m: le exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of B.Sc. etit, B.	t he module .Sc. MEC, B.Sc. Med	Tec, B.Sc. CE, B.S	c. iST, B.Ed. etit, B	.Sc. WI-eti	t		
8	Grade bonu A grade imp	is compliant to §25 provement of up to 0,	(2) 4 due to a bonus i	is possible, which c	an be earn	ed with te	sts.	
9	References Lecture Slid	e Copies; Richard Ja	eger: Microelectro	onic Circuit Design				
Coι	ırses							
	Course nr. 18-ho-1011-	-vl Electronics						
	Instructor M.Sc. Oliver	r Bachmann, Prof. Dr	Ing. Klaus Hofm	ann		Type Lecture		SWS 2

Course nr. 18-ho-1011-ue	Course name Electronics		
Instructor M.Sc. Oliver Bac	hmann, Prof. DrIng. Klaus Hofmann	Type Practice	SWS 1

Mo	dulo nomo							
Eleo	ctronic and In	tegrated Circuits						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
18-1	ho-1020	6 CP	180 h	120 h 1 Term Summer term				
Lan Ger	i guage man			Module owner Prof. DrIng. Kla	us Hofmanı	n		
1	Teaching co Basic analog Circuits; Mu Feedback Teo	ntent Building Blocks: C lti Stage Amplifier, : chniques, Frequency	urrent- and Volta internal Structure Response, Clock (ge sources, Stabiliz and Properties of Generation and Ose	zing circuit Differentia cillators	s, Current al and Ope	t Mirrors, Re erational Am	ference plifiers,
2	2 Learning objectives A student is, after successful completion of this module, able to							
	 derive the fundamental properties of the MOS-Transistors from knowledge of the layout or fabrication process, derive fundamental MOSFET-circuits (current source, voltage source, current mirror, switch, active resistors, inverting amplifiers, differential amplifiers, output amplifiers, operational amplifiers, comparators) and knows their fundamental properties (y-Parameters, DC- and AC-properties), understands simulation methods for analog circuits on transistor level using SPICE, analyze feedback amplifiers regarding frequency gain, stability, bandwidth, root locus, amplitude and phase-margin, Analyze electronic circuits for voltage and current provision, Analyze basic circuits for clock/waveform generation 							
3	Recommend Lecture "Elec	led prerequisites for etronics"	or participation					
4	Form of exa Module exan • Module	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., De	efault RS)		
5	Prerequisite Passing the f	e for the award of c inal module examina	redit points ation					
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. MEC	C, M.Sc. CE, B.Ed.	etit, B.Sc. und M.S	Sc. iST, B.S	c. WI-etit		
8	Grade bonu A grade imp	s compliant to §25 rovement of up to 1,	(2) 0 due to a bonus i	s possible, which c	an be earne	ed with te	sts.	
9	References Lecture Slide	e Copies; Richard Jae	eger: Microelectro	nic Circuit Design				
Coι	ırses							
	Course nr. 18-ho-1020-	vl Analog Integra	ated Circuit Desig	ı				
	Instructor Prof. DrIng.	Klaus Hofmann				Type Lecture		SWS 3

Course nr. 18-ho-1020-ue	Course name Analog Integrated Circuit Design		
Instructor Prof. DrIng. Kla	us Hofmann	Type Practice	SWS 1

Mo	dule name	in DCP Decign					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle
18-	ho-1110	6 CP	180 h	120 h	1 Term	Winter tern	n
Lar Ger	iguage man			Module owner Prof. DrIng. Kla	us Hofmann		
1	Teaching co Printed circu	ontent 1it board (PCB) layou	ut, PCB stackups,	PCB recycling, relia	ability		
2	2 Learning objectives After attending the lecture and exercise students are able to layout multilayer printed circuit boards (PCBs) based the requirements of the circuit's schematic. Students know how PCBs are manufactured and how manufacturing affects the layout. They have mastered the design rules for rigid, rigid-flex and flex PCBs. They are well versed in the basics of: signal integrity for high-speed signals; PCB level EMI; recycling and circular economy for PCBs; PCB assembly and IC packaging: PCB reliability.					i) based icturing l versed or PCBs;	
3	Recomment "Electronics"	ded prerequisites fo lecture, "Electronics	or participation				
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 						
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exan • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. und M.Sc. iST, B	S.Sc. WI-etit				
8	Grade bonu Possible, gra a successful manufactura	ade bonus up to 0,4 participation regula able PCB layout is red	(2) following 25 (2) ar attendance (= quired.	APB for successfu 75 %) of the desig	l participation in the n reviews as well as	e integrated l the submissi	ab. For ion of a
9	References						
Coι	ırses						
	Course nr. 18-ho-1110-	vl Advanced Top	ics in PCB Design				
	Instructor DrIng. Ferd	linand Keil			Type Lecture		SWS 2
	Course nr. 18-ho-1110-	Course nameueAdvanced Top	ics in PCB Design				
	Instructor DrIng. Ferd	linand Keil			Type Practice		SWS 1
	Course nr. 18-ho-1110-	pr Advanced Top	ics in PCB Design				
	Instructor DrIng. Ferd	linand Keil			Type Lab		SWS 1

Mo	dule name	neversorgung I / Dou	war Systems I					
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
Lar Ger	nguage man	5 CP	130 11	Module owner Prof. DrIng. Jutt	ta Hanson			.1
1	1 Teaching content Three-phase network and symmetrical components; overhead lines; cables; transformers; calculation of short- circuit currents; switch equipment; switchgears							
2	 2 Learning objectives Upon completion of the module, students will have learned: Presentation of components of power system Functional elaboration of equipment Calculation of the component rating Impact on the electrical power system 							
3	Recomment comparable	led prerequisites for competences to the r	or participation module "Power En	gineering"				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 6 students register, the examination will be an oral examination (duration: 30 min.). The type of examination 							
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weighti	ng: 100 %)	
7	Usability of B.Sc. etit, M	the module .Sc. etit - EET, M.Sc.	WI-etit, B.Sc. CE	, B.Ed. etit, B.Sc. u	nd M.Sc. i	ST, B.Sc. V	WI-etit	
8	Grade bonu	s compliant to §25	(2)					
9	References Script, lectu	re slides, guiding qu	estions, excercises					
Coi	ırses							
	Course nr. 18-hs-1010-	vl Elektrische En	ergieversorgung I	/ Power Systems I				
	Instructor M.Sc. Felix I	Korff, Prof. DrIng. J	utta Hanson, M.Se	c. Manuel Schwenk	æ	Type Lecture		SWS 2
	Course nr. 18-hs-1010-	Course name Lektrische En	ergieversorgung I	/ Power Systems I				
	Instructor M.Sc. Felix I	Korff, Prof. DrIng. J	utta Hanson, M.Se	c. Manuel Schwenk	xe	Type Practice		SWS 2

Mo	dule name						
Ele	ctrical Engine	ering Systems	1			1	
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	hs-1100	4 CP	120 h	/5 h	1 Term	Summer te	rm
Ger	German Prof. DrIng. Jutta Hanson						
1	 Teaching content The module covers the following content with focus on power engineering: Advanced network theory: Common mode and differential mode, three-phase systems, four-pole theory. Transients in time domain and in frequency domain: switching on and off processes, resonant circuits Coupling of electrical and mechanical systems (mode of operation, equivalent circuit diagram, signal models): transformer, electrical machines Electrical behavior of lines/line theory (steady state and transients) 						
2	Learning objectives The students know the steady-state and dynamic behavior of three-phase systems for selected equipment and are able to calculate this mathematically. They can describe the interaction of electrical and mechanical systems using the example of the transformer and electrical machines. The electrical behavior of lines is known. A basic understanding of switching operations in the electrical network is gained.						
3	Recommended prerequisites for participation Electrical Engineering and Information Technology I (18-hs-1070), Electrical Engineering and Information Technology II (18-gt-1020), Deterministic Signals and Systems (18-kl-1010)						
4	Form of exa Module exar • Module	mination n: e exam (Technical e:	xamination, Exam	ination, Duration:	120 Min., Default RS	5)	
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation				
6	Grading Module exar • Module	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. CE, I	B.Sc. WI-etit				
8	Grade bonu	s compliant to §25	(2)				
9	References						
	• Lecture slides (download)						
Co	urses						
	Course nr. 18-hs-1100-v	Course name A Electrical Engi	ineering Systems				
	InstructorTypeSWSProf. DrIng. Jutta HansonLecture2						

Course nr. 18-hs-1100-ue	Course name Electrical Engineering Systems		
Instructor Prof. DrIng. Jut	ta Hanson	Type Practice	SWS 1

Mo Fur	dule name adamentals of	Communication				
Mo 18-	Module nr.Credit pointsWorkloadSelf-studyModule durationModule cycle18-jk-10106 CP180 h120 h1 TermSummer term					Module cycle Summer term
Lar Ger	LanguageModule ownerGermanProf. DrIng. Rolf Jakoby					
1	 Teaching content Part 1 Fundamentals of Signal Transmission: Chap. 1 will be a brief introduction in "Electrical Information- and Communication Engineering", presenting signals as carrier of information, classifying electrical signals and describing elements of communication systems. Then, Chap. 2 introduces various line-conducted and wireless transmission media, power budget calculations for both media types, basics of antenna radiation and parameters etc., which will be emphasized by application examples like TV-satellite reception and mobile communication channels. Chap. 3 is focused on signal distortions and interferences, especially thermal noise, considering noisy two-port devices and its concatenations, lossy networks, antenna noise temperature and the impact of noise on analog and digital signals. This chap. ends with basics of information theory and channel capacity for AWGN-channels. In contrast, chap 4 deals with some fundamentals of noise-reduction and distortion-compensation techniques. Part 2 Digital Baseband-Signal Processing: Chap. 5 introduces sampling of band-limited signals and analog modulation of a pulse carrier (pulse-amplitude-, pulse-duration- and pulse-angle-modulation), which will be extended in chapter 6 on digital modulation in the baseband by means of pulse-code modulation (PCM), focusing on signal quantizing, analog-digital conversion, minimum bandwidth, bit error rate and error probability of a PCM word. At least, PCM-time-division multiplex and -systems will be discussed. Chap. 7 introduces band-limited inter-symbol interference-free transmission and matched filtering in the baseband. Part 3 Analog Radio Frequency (RF) Signal Processing: Chap. 8 deals with fundamentals of multiplex- and RF-modulation schemes as well as with frequency conversion, frequency multiplication and mixing strategies. Then, receiver principles and image frequency problems of heterodyne-receivers as well as amplitude modulat					
	the function	ath and power efficients and power efficients and power efficients and the second seco	ency of these mo- ling and interleav equires most of th	ing is given in orce e learned content of	ler to assess the per of this lecture.	formances of digital
2	Learning of Aim of the D of signals fro how to deter basement fo A, B), Micro	bjectives Lecture: To teach the om a source to a sink, rmine the performand r further lectures like wave Eng., Optical C	e fundamentals of possible modulati ces of digital comr Communication T ommunications ar	communications (µ on and access meth nunication systems Technology, Laborat nd Mobile Commun	ohysical layer), prima nods, signal distortior . The introduction of cories of Communicat nications.	arily the transmission and noise as well as communications is a ion Technology (NTP
3	Recommended prerequisites for participation Deterministic Signals and Systems					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 					
5	Prerequisit Passing the	e for the award of c	redit points ation			
6	Grading					

1	Modulo ovom					
	Module exam (Technical examination, Examination, Weighting: 100 %)					
7	Usability of the	module				
	B.Sc. etit, B.Sc. 1	MEC, B.Sc. CE, B.Sc. iST, B.Ed. etit, B.Sc. WI-etit				
8	Grade bonus co	mpliant to §25 (2)				
9	References	and Literature.				
	• Pehl, E.: D	igitale und analoge Nachrichtenübertragung, Hüthig Verlag				
	 Meyer, Mar 	tin: Kommunikationstechnik, Vieweg				
	• Stanski, B.	Kommunikationstechnik				
	Kammeyer	K.D.: Nachrichtenübertragung. B.G. Teubner				
	• Mausl, R.:	Digitale Modulationsvertahren. Huthig Verlag				
	• Haykin, S.: • Droakis J	Communication Systems. John Wiley	-11			
	• 7iemer R	Peterson R · Digital Communication Prentice Hall				
	• Cheng, D.:	Field and Wave Electromagnetics. Addision-Wesley.				
Co	urses					
	Course nr.	Course name				
	18-jk-1010-vl	Fundamentals of Communications				
	Instructor Type SWS					
	Prof. DrIng. Rolf Jakoby 2					
	Course nr. Course name					
	18-jk-1010-ue Fundamentals of Communications					
	Instructor Type SWS					
	Prof. DrIng. Rol	f Jakoby	Practice	1		

Mo Mic	dule name rowave Engir	neering I				
Mo 18-	dule nr. jk-1020	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration 1 Term	Module cycle Winter term
Lar Ger	LanguageModule ownerGermanProf. DrIng. Rolf Jakoby					
1	 Teaching content Electromagnetic (EM) Properties of Materials: 1.) Microscopic Scale, including energy levels and energy bands, charge carriers and conduction; 2.) Macroscopic Scale, including plane waves in homogeneous lossy media, electromagnetic properties of low-loss media (lossy dielectrics), skin effect in good conductive media (metals & alloys), penetration depth in biological tissues and specific absorption rate (SAR), oblique incidence of plane waves at a dielectric interface, mechanisms of polarization in dielectrics and its applications, losses in dielectrics, applications of (electro)ceramics; Interaction between Electromagnetic Waves and Biological Materials (Bioelectricity, Dielectric Dispersion in Tissues, Relaxation and Resonances, Microwave Dosimetry, SAR and thermal considerations, Exposure of Body to Cell Phone and Base Station) Passive RF Circuits with R-, L- and C-Lumped Elements: Resonant and Equivalent RLC Circuits, Graphical Representation of RF Circuits with the Smith Chart, Lumped-Element Impedance Matching. Theory and Applications of Transmission Lines: Propagation Modes in Transmission Lines, General Transmission Line Equations (lumped-element model, transmission-line parameters, wave propagation along a transmission line); Wave Characteristics on Transmission Lines from input-port and output-port parameters of the line; Lossless Transmission Lines as Circuit Elements; Transmission-Line Terminations; Transmission-Line Impedance Matching, including quarter-wave transformer, impedance of a half-wave section and single-stub and double-stub matching; Left-Handed Metamaterial Lines and Dispersion. Scattering-Matrix Formulation of Microwave Networks: Scattering-Matrix Formulation; Characterization of Microwave Networks; Input and Output Reflections of Unmatched Microwave Networks; Concatenation and Transformations of Scattering Matrixes; ABCD-Matrix Formulation. 					
	N-Port Mic T-junction Po Power Divid N-Port Comp	rowave Devices: For Divider, Symme er (Coupled Line Dire pound Devices with e	Power Divider an trical, Resistive T- ectional Coupler, T examples of Interf	d Power Combine Junction Power Div The Quadrature Hy erence-based RF Sy Quasi-Optical Appr	er: Three-Port Powe ider, Wilkinson Powe brid, The 180°-Hybri witch and Butler Mat	er Divider (Lossless er Divider); Four-Port d Coupler); In-plane rix.
	Equations; I Conductor L	Parallel-Plate Wavegu .osses); Microstrip Lin	uide; Rectangular nes.	Waveguide; Atter	uation in Waveguide	es (Dielectric Losses,
2	 Learning objectives Students understand the essentials of RF engineering: passive RF components and circuits with discrete elements and line components, line theory, application of scattering matrices to describe passive and active RF components waveguides: theory, propagation and losses. 					
3	Recomment Communica	ded prerequisites fo tions engineering, fu	or participation ndamentals of tec	hnical electrodyna	mics	
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 					
5	Prerequisite Passing the	e for the award of c	redit points ation			

6	Grading Module exam: • Module exa	GradingModule exam:Module exam (Technical examination, Examination, Weighting: 100 %)						
7	Usability of the	module						
	B.Sc. etit, M.Sc.	WI-etit, B.Sc. CE, B.Ed. etit, B.Sc. und M.Sc. 151, B.Sc. WI-etit	t					
8	Grade bonus co	mpliant to §25 (2)						
9	References Script is in Engl recommended in	ish and will be ellectronically hand out at the beginning of first lecture	the letcture; Literature	will be				
	Course nr. 18-jk-1020-vl	Course name Microwave Engineering I						
	Instructor Prof. DrIng. Rol	f Jakoby	Type Lecture	SWS				
	Course nr. Course name 18-jk-1020-ue Microwave Engineering I							
	Instructor Prof. DrIng. Rol	f Jakoby	Type Practice	SWS 1				

Mo Hig	dule name h Voltage Tec	chnology I				
Module nr. Credit points Workload Self-study Module duration Module cycle 18 kc.1010 5 CP 150 h 90 h 1 Term Winter term						
18-kc-1010 5 CP 150 h 90 h 1 Term Winter term Language German Module owner Prof. Dr. Myriam Koch					whiter term	
1	Teaching content Calculation of electrostatic fields, voltage distribution in insulating systems and layered dielectrics, field and potential control measures, breakdown of gases, surface discharge and pollution flashover, vacuum breakdown, generation and measurement of high voltages.					
2	 2 Learning objectives After participating in the module, students will be able to explain fundamental phenomena and principles related to high electric fields and they will be able to identify critical, highly stressed regions in electric field maps. They will be able to perform field optimizations through specific design of the dielectric materials and field-controlling geometries. They understand the various mechanisms that lead to failure of a gas-insulated systems, know which parameters affect their electrical strength, and can apply design criteria. They can identify weak points in the insulation system and propose improvements. They will be able to make an estimation of the breakdown or flashover voltage, respectively. Students will be able to identify regions with potential surface discharges and know how pollution flashover develops and how it can be avoided. Students will be able to explain the processes involved in vacuum breakdown and how it differs from gas breakdown. Furthermore, the students are able to explain the most important designs for high-voltage generators and to name suitable measuring equipment. 					
3	Recommended prerequisites for participation					
4	Form of exa Module exa • Modul With up to 2 written exar	amination m: e exam (Technical ex 20 participants the ex n (duration: 120 min	xamination, Oral/ xamination will ta a). The type of exa	written examinatio ke place as an oral mination will be a	n, Duration: 120 Mir exam (duration: 30) nnounced at the begi	n., Default RS) min), otherwise as a nning of the lecture.
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of B.Sc. etit, M	the module I.Sc. ESE, M.Sc. etit -	- EET, B.Sc. CE, B.	Ed. etit, B.Sc. und	M.Sc. iST, B.Sc. WI-	etit
8	Grade bonus compliant to §25 (2) Grade improvements up to 0.4 according to APB 25 (2) through bonus for successful participation in the internship.					
9	References					
	KüchleBeyer,	er, A.: High Voltage T M.; Boeck, W.; Mölle	echnology, Spring er, K.; Zaengl, W.:	er Hochspannungstee	chnik, Springer-Verla	g
Cou	irses					

Course nr. 18-kc-1010-vl	Course name High Voltage Technology I		
Instructor Prof. Dr. Myriam	Koch, M.Sc. Manuel Philipp	Type Lecture	SWS 2
Course nr.Course name18-kc-1010-ueHigh Voltage Technology I			
Instructor Prof. Dr. Myriam	Koch, M.Sc. Manuel Philipp	Type Practice	SWS 1
Course nr. 18-kc-1010-pr	Course name High Voltage Technology I		
Instructor Prof. Dr. Myriam	Koch	Type Lab	SWS 1

Mo	dule name	male and Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-KI-1010 / CP 210 n 135 n 1 ferm winter term Language Module owner						willer term
German Prof. DrIng. Anja Klein						
1	Teaching co Examples of Specific sign time repress Fourier Serie of the Fourier Fourier Tran function - st into partial Representat Parseval's th Systems and applications Laplace Tra examples an Linear differ and applicat Discrete sign exponential z-Transform examples an fraction exp Discrete Sys systems, line FIR-systems Signal Samp theorem, pr Discrete Fou properties, in	ontent signals and systems, nals, generalized func- enation of signals and es: Motivation; Fourier er series, convegence sform: Motivation - D ep function - propert fractions tion of signals and sy ecorem - properties-en- l Signals: Bandlimited nsform: Motivation ad applications ential equations: Tim- tions nals: series of numbers sequence, periodicity to motivation, relation ad applications, prop- ansion. tems: general descrip- ear difference equation. tems: general descrip- ear difference equation.	etions, impulse fur l systems, linear ti r series with real co conditions, examp eriviation from For ies of Fourier-tran ystems in frequency amples and appli and time limited - single sided L-tr e invariant system s, relationship disc y in frequency and onship to Laplace- perties of the z-Tran ption, properties, i cons, discrete time ion: ideal sampling n (DTFT): motivation, relation actical aspects, cyce	action, step function ime invariant system pefficients; Fourier s ples and application urier series - Dirichle isform - special case cy domain, Time in ications systems - systems v ransform - inverse s,equivalent circuits rete and continuous 1 time. Transform, definit: ansform, discrete of LTI systems, impuls and image area, tr g and reconstruction tion, relationship t isform, system deso ionship to DTFT, de clic convolution.	n, ms, impulse response eries with complex cons et conditions - genera es - examples and ap avariant systems, convith only one energy L-transform - theore is for passive electrical is signals, impulse seq ion one-sided z-Trans convolution, inverse se response, step resp ansfer function, block in in time and frequent o Fourier-Transform cription via DTFT, Pa finition of DFT, example	e, convolution pefficients; properties lized functions, delta oplications, expansion nvolutions theorem,- store - examples and ems of L- transform - l elements - examples uence, step sequence, asform, convergence, z-Transform, partial ponse, connection of k diagrams, IIR- and acy domain, sampling , definition of DTFT, rseval's Theorem. ples and applications,
	2 Learning objectives The students should understand the principles of integral transformations and discrete transformations and be able to apply them to physical and technical problems. The students shall be able to mathematically describe and analyse continuous and discrete signals and systems (LTI) in time domain and in the corresponding image area. The techniques of this module are essential tools which will be needed in many follow up modules					
3	Recommen Elektrotechi	ded prerequisites fo	or participation technik I und Elek	trotechnik und Inf	ormationstechnik II	
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 					
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			

(Creating						
0	Grading Module exam:						
	Module exam. Module exam (Technical examination Examination Weighting: 100 %)						
	module exam (recimical examination, Examination, weighting, 100 /0)						
7	Usability of the	module					
	B.Sc. etit, B.Sc. M	MEC, M.Sc. CE, B.Sc. MedTec, B.Sc. CE, B.Sc. iST, B.Ed. etit, E	3.Sc. WI-etit				
8	Grade bonus co	mpliant to §25 (2)					
	Yes, if not feasibl	e in presence					
9	References						
	The slides of the	lecture, documentation for the exercises and numerous additio	nal documents will be p	rovided			
	in electronic forn	1.					
	Basic Literature:						
	A. Fettweis	, Elemente nachrichtentechnischer Systeme, Teubner Verlag,	, 2. Auflage, Stuttgart/	Leipzig,			
	• S Soliman	and M.D. Srinath Continuous and Discrete Signals and Syste	ems Drentice Hall New	. Iersew			
	1990	and M.D. Siman, Continuous and Discrete Signals and Syste	lins, richtee fian, new	JCISCy,			
	• T. Frey, M.	Bossert, Signal- und Systemtheorie, Teubner Verlag, 2004					
	H. Clausert	, G. Wiesemann "Grundgebiete der Elektrotechnik 2", Oldenbo	ourg, 1993.				
	 Otto Fölling 	ger "Laplace-, Fourier- und z-Transformation", Hüthig, 2003.					
	• Exercises:						
	• Hwei Hsu "	Signals and Systems", Schaum's Outlines, 1995					
Co	urses			-			
	Course nr.	Course name					
	18-kl-1010-vl	Deterministic Signals and Systems		1			
	Instructor Type SWS						
	Prof. DrIng. Anja Klein, Prof. DrIng. Marius PesaventoLecture3						
	Course nr. Course name						
	18-kl-1010-ue Deterministic Signals and Systems						
	Instructor Type SWS						
	Prof. DrIng. An	ja Klein, Prof. DrIng. Marius Pesavento, M.Sc. Maximilian	Practice	2			
	Wirth						

Mo Cor	Module name Communication Technology I						
Mo	dule nr. kl-1020	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration	Module cycle Winter term	
Language Module owner German Prof. DrIng. Anja Klein							
1	Teaching content Signals and Communication Systems, Base-band Communications, Detection of Base-band Signals in AWGN Channels, Bandpass-Signals und -Systems, Linear Digital Modulation Schemes, Digital Modulation und Detection, Multi-carier Transmission, OFDM, Spread-Spectrum Techniques, CDMA, Multiple Access						
2	 Learning objectives After completion of the module, students possess the ability to: classify signals and communication systems, understand, model and analyse basic components of communication systems, understand, evaluate and compare communication systems for transmission over additive white Gaussian noise channels, model and analyse base-band commnication systems, describe and analyse bandpass signals and bandpass communication systems in the equivalent base-band, understand, model, evaluate, compare and apply linear modulation schemes, design receiver structures for different modulation schemes, detect linear modulated data after transmission over additive white Gaussian noise channels in an optimum way, understand and model OFDM, understand and model CDMA, understand and compare the basic properties of multiple access schemes. 						
3	Recommend Electrical En Theory, Scie	ded prerequisites fo gineering I and II, De ntific Computing	or participation eterministische Sig	nale und Systeme,	Mathematics I to III,	Statistics/Probability	
4	Form of exa Module exar • Modul	mination m: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)		
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	 Grading Module exam: Module exam (Technical examination, Examination, Weighting: 100 %) 						
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. CE, M	M.Sc. iST, B.Ed. et	tit, B.Sc. WI-etit			
8	Grade bonu	is compliant to §25	(2)				
9 Co1	References Will be anno	ounced in the lecture					

Course nr. 18-kl-1020-vl	Course nr.Course name18-kl-1020-vlCommunication Technology I				
Instructor		Type	SWS		
Prof. DrIng. Anja Klein		Lecture	3		
Course nr. 18-kl-1020-ue	Course name Communication Technology I				
Instructor		Type	SWS		
Prof. DrIng. Anja Klein, M.Sc. Wanja de Sombre, M.Sc. Bernd Simon		Practice	1		

Mo Me	dule name asurement Tech	nology						
Mo 18-	dule nr. kn-1010	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module d 1 Term	uration	Module cyc Summer ter	:le rm
Lar Ger	nguage man		120 11	Module owner Prof. Dr. Mario Kupnik				
1	1 Teaching content Extent and Meaning of electrical measurement technology, units and measurement systems, description of measurement systems and signals, systematic and stochastic errors, relative and reduced errors, measurement uncertainty, analogue measurement of electrical parameter, power measurement in single- and three-phase systems, impedance measurements, use of oscilloscopes, measurement amplifier and filter, signal conversion (ADC, DAC), frequency and time measurements, data handling, digital data acquisition.							
2	2 Learning objectives Students know the configuration and properties of electric and electronic measurement equipment and circuits and are able to apply them to measurement tasks. They know the basics of data aquisition, handling, transmission and storage and are able to describe and quantify measurement errors.							
3	Recommende ETiT I & II, Ma	d prerequisites fo athematics I-III	or participation					
4	Form of exam Module exam: • Module	iination exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., De	efault RS)		
5	Prerequisite f Passing the fin	For the award of c al module examination	redit points ation					
6	Grading Module exam: • Module	exam (Technical e	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of the B.Sc. etit, B.Sc.	ne module c. MEC, B.Sc. Med'	Tec, B.Sc. CE, B.E	d. etit, B.Sc. und M	1.Sc. iST, B.	Sc. WI-et	it	
8	Grade bonus	compliant to §25	(2)					
9	References Slides, Textbo	ok Lerch: "Elektris	che Messtechnik",	Springer				
Co	ırses							
	Course nr. 18-kn-1011-vl	Course name Measuring Tec	chnique					
	Instructor Prof. Dr. Mario	o Kupnik				Type Lecture		SWS 2
	Course nr. 18-kn-1011-ue	e Course name Measuring Tec	hnique					
	Instructor Prof. Dr. Mario	o Kupnik				Type Practice		SWS 1

Mo Elec	dule name ctromechanica	l Systems I						
Mo	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cy	cle
Lan Ger	nguage man	5 Gr	150 11	Module owner Prof. Dr. Mario Ki	upnik		winter tern	11
1	Teaching co Structure an transducers b	ntent d design methods o between mechanical	of elektromechani and acoustical net	cal systems, mecha works. Design and	anical, aco devices of	ustical and	d thermal ne chanical trans	tworks, sducers.
2	2 Learning objectives The module provides the following competencies upon successful completion: Comprehension, description, cal- culation and application of the most relevant electromechanical transducers, comprising electrostatic transducer (e.g. microphone and accelerometer), piezoelectric transducers (e.g micro motors, micro sensors), electrody- namic transducer (loudspeaker, shaker), piezomagnetic transducer (e.g. ultrasonic source). Design of complex electromechanical systems like sensors and actuators and their applications by applying the discrete element network method.							
3	Recommend Electrical En	led prerequisites for gineering and Inform	or participation nation Technology	r I				
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 							
5	Prerequisite for the award of credit points Passing the final module examination							
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting:	100 %)			
7	Usability of B.Sc. etit, M.	the module .Sc. MEC, B.Sc. CE,	M.Sc. iCE, B.Sc. u	nd M.Sc. iST, B.Sc	. WI-etit			
8	Grade bonu	s compliant to §25	(2)					
9	References Book: Electro chanical Syst	omechanical Systems ems I, Workbook	in Microtechnic u	nd Mechatronic, Sp	oringer 201	2, Script f	or lecture Ele	ectrome-
Cou	ırses							
	Course nr. 18-kn-1050-	vl Electromechar	nical Systems I					
	Instructor Prof. Dr. Ma Binder	ario Kupnik, M.Sc.	Omar Dali, Prof.	Dr. techn. Dr.h.c.	Andreas	Type Lecture		SWS 2
	Course nr. 18-kn-1050-1	ue Electromechar	nical Systems I					
	Instructor Prof. Dr. Ma Binder	ario Kupnik, M.Sc. (Omar Dali, Prof.	Dr. techn. Dr.h.c.	Andreas	Type Practice		SWS 2

Mo Eleo	dule name ctrical Engine	ering and Informatio	n Technology I			
Mo	dule nr. kn-1070	Credit points	Workload 210 h	Self-study 135 h	Module duration	Module cycle Winter term
Lar Ger	nguage man	, 01		Module owner Prof. Dr. Mario Ki	upnik	
1	 Teaching content Units and Equations: Unit systems, equation writing. Basic definitions: Charge, current, voltage, resistance, energy and power. Currents and voltages in electrical circuits: Ohmic law, node and mesh equations, parallel and series connections, current and voltage measurement, linear and nonlinear elements, superposition method, star-delta-transformation, node and mesh analysis in linear circuits, controlled sources. AC systems: Time-dependent currents and voltages, steady-state mode sinusoidal currents and voltages in linear RLC-circuits, phasor diagrams, resonances in RLC circuits, AC power, locus diagrams, two-port networks, transformer, polyphase systems. 					
2	 2 Learning objectives After successful completion of the module students are able: to utilize the basic equations in electrical engineering, to determine the currents and voltages in linear and nonlinear circuits, to analyze DC and AC systems, to calculate simple filter and resonant circuits, to apply the complex calculation in electrical AC systems. 					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisit Passing the	e for the award of c	redit points ation			
6	Grading Module exame • Module	m: le exam (Technical ex	xamination, Exam	ination, Weighting:	: 100 %)	
7	Usability of B.Sc. etit, B	the module .Sc. MEC, B.Sc. Med	Tec, B.Sc. CE, B.S	c. iST, B.Ed. etit, B	.Sc. WI-etit	
8	Grade bonu	is compliant to §25	(2)			
9	References					
	FrohmeClause	e, H. u.a. Moeller Gru ert, H. u.a. Grundgeb	undlagen der Elek iete der Elektrotee	trotechnik chnik 1 + 2		
Coι	ırses					

Course nr. 18-kn-1070-vl	Course name Electrical Engineering and Information Technology I		
Instructor Prof. Dr. Mario Kupnik, M.Sc. Felix Herbst		Type Lecture	SWS 3
Course nr. 18-kn-1070-ue	Course name Electrical Engineering and Information Technology I		
Instructor Prof. Dr. Mario K	upnik, M.Sc. Felix Herbst, M.Sc. Alexander Altmann	Type Practice	SWS 2

Mo	dule name	ory I: Fundaments					
Mo	dule nr.	Credit points	Workload	Self-study	Module durati	on Module cy	cle
Lan Eng	nguage	0 CP	180 11	Module owner Prof. Dr. techn. H	l lerni	winter teri	<u>11</u>
1	 Teaching content This lecture course introduces the fundamentals of information theory, network information theory and coding theory. Outline: information, uncertainty, entropy, mutual information, capacity, differential entropy, typical sequences, Gaussian channels, basics of source and channel coding, linear block codes, Shannon's source coding theorem, Shannon's channel coding theorem, capacity of Gaussian channels, capacity of bandlimited channels, Shannon's bound, bandwidth efficiency, capacity of multiple parallel channels and waterfilling, Gaussian vector channel, Multiple Access Channel, Broadcast Channel, rate region. 						
2	Learning objectives Upon completion of the module, students will have an understanding of the fundamentals of classic information theory.						
3	Recommended prerequisites for participation Basic knowledge of probability theory						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 						
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	Grading Module exame • Module	n: e exam (Technical e:	xamination, Exam	ination, Weighting	100 %)		
7	Usability of B.Sc. etit, M	the module Sc. CE, B.Sc. CE, M	.Sc. iCE, B.Ed. eti	t, B.Sc. und M.Sc.	ST, B.Sc. WI-eti	, M.Sc. etit - CM	EE
8	Grade bonu	is compliant to §25	(2)				
9	References						
	 T.M. Cover and J.A. Thomas, Elements of Information Theory, Wiley & Sons, 1991. R. W. Yeung, Information Theory and Network Coding, Springer, 2008. Abbas El Gamal and Young-Han Kim, Network Information Theory, Cambrige, 2011. 						
Coι	urses						
	Course nr. 18-kp-1010-	vl Information T	heory I: Fundame	nts			
	InstructorTypeSWSProf. Dr. techn. Heinz Köppl, M.Sc. Anam TahirLecture3						

Course nr. 18-kp-1010-ue	Course name Information Theory I: Fundaments		
Instructor Prof. Dr. techn. H	leinz Köppl, M.Sc. Anam Tahir	Type Practice	SWS 1

Mo Bio	dule name informatics I					
Mo 18-	dule nr. kp-1020	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration	Module cycle Winter term
Lar Ger	n guage man/English	1	I	Module owner Prof. Dr. techn. Heinz Köppl		
1	Image: Teaching content Prof. Dr. techn. Heinz Koppi Image: Teaching content • Biomolecular foundations of high-throughput measurement techniques (Microarrays, RNA-Seq, genome sequencing, proteinarrays, mass-spectrometry, flow-cytometry, mass-cytometry, genomics, proteomics, metabolomics) • Foundations of statistics and machine learning (decision theory, regression, classification and clustering) • Exact substring search, dynamic programming, algorithms for sequence comparison (PAM, BLAST, BLAST2, etc), alignment of multiple sequences (ClustalW, DAlign, etc) • Important databases in bioinformatics and their use in medicine and biology (GenBank, Gene Expression Omnibus, Rfam, UniProt, Pfam, KEGG, BRENDA, Pathway Commons) • Analysis of interaction networks (modularity, graph partitioning, spanning trees, differential network analysis, network motifs, STRING database, PathBLAST) • Introduction to structural biology, structure prediction for RNA and proteins, Protein Data Bank (PDB)					
2	2 Learning objectives After successful completion students are aware of frequently used high-throughput methods in molecular biology and are familiar with the resulting data format. They know the most important bioinformatics databases and acquired the necessary background to understand standard bioinformatics algorithms and to implement them from scratch in R or Matlab. Students are familiar with the basics of structural analysis and with structure prediction. With respect to communication skills, students learned to exchange informatio, ideas, problems and solutions related to bioinformatics with experts and with lay persons.					
3	"General Co	mputer Science I"	or participation			
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing of M	e for the award of c Iodule final exam	redit points			
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. MedTe	the module ec, B.Sc. und M.Sc. is	ST, B.Sc. WI-etit, I	M.Sc. etit - CMEE		
8	Grade bonu	is compliant to §25	(2)			
9	References					
Coi	ırses					

Course nr. 18-kp-1020-vl	Course name Bioinformatics I		
Instructor Prof. Dr. techn. H	Heinz Köppl	Type Lecture	SWS 2

Mo Mic	dule name roelectronic I	Devices				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Ger	nguage man/English	401	120 11	Module owner Prof. Dr. rer. nat.	Sascha Preu	winter term
1	Teaching co	ontent		1		
	 Introduction: Semiconductor Devices & Microelectronic Semiconductor: Materials, Physics & Technology PN-Junction Metal-Oxide-Semiconductor Capacity Schottky Contact MOS-Field-Effect-Transistor (MOSFET) CMOS: Digital Applications MOS-Memory Bipolar- Junction-Transistor Outlook: Scaling Limits & SET, 					
2	 Learning objectives Upon completion of the module, students will have developed an understanding of 					
3	Recommen Electrical En Laboratory I	ded prerequisites fo ngineering and Infor ETiT, Laboratory Elec	or participation mation Technolog ctronics, Mathema	gy I, Electrical Eng tics I, Mathematics	ineering and Inform II, Physics	nation Technology II
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exa • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. CE, E	3.Ed. etit, B.Sc. u	nd M.Sc. iST, B.Sc.	WI-etit	
8	Grade bonu Yes	s compliant to §25	(2)			
9	References					

Skript: Microelectronic devices - the Basics

- 1. Robert F. Pierret: Semiconductor Device Fundamentals, ISBN 0201543931
- 2. Roger T. How, Charles G. Sodini: Microelectronics an Integrated Approach, ISBN 0135885183
- 3. Richard C. Jaeger: Microelectronic Circuit Design, ISBN 0071143866
- 4. Y. Taur, T.H. Ning, Fundamentals of Modern VLSI Devices, ISBN 0521559596
- 5. Thomas Tille, Doris Schmidt-Landsiedel: Mikroelektronik, ISBN 3540204229
- 6. Michael Reisch: Halbleiter-Bauelemente, ISBN 3540213848

Courses

0	Juises						
	Course nr.Course name18-pr-1030-vlMicroelectronic Devices						
	Instructor Prof. Dr. rer. nat. Sascha Preu		Type Lecture	SWS 2			
	Course nr. 18-pr-1030-ue	Course name Microelectronic Devices					
	Instructor Prof. Dr. rer. nat.	Instructor Prof. Dr. rer. nat. Sascha Preu		SWS 1			

Мо	dule name					
Opt	tical Commun	ications - Componen	ts	1		1
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	pr-1050	6 CP	180 h	120 h	1 Term	Summer term
Lan Eno	iguage dish			Module owner Prof. Dr. ror. pat. Sascha Brou		
1	Teaching co	ntont		Tion Di Ten nut	buschu i reu	
1	 Teaching content The lecture discusses the working principle of the most important devices and components of modern telecommunication networks and optical data transmission systems. The starting point will be basic physical principles: The nature of light Wave equation Polarization Absorption, transmission, reflection, refraction Mirrors, HR-/AR coatings Waveguides Fiber-optic waveguides Attenuation, modes, dispersion Fiber types Connectors and splices Dispersion and dispersion compensation Kerr nonlinearity and self-phase modulation Components, e.g.: Optical filters Wavelength division multiplexers Magneto-optical effect / optical isolator / circulator Electro-optic modulator Lasers Basics, concepts, types Erbium-doped fiber lasers / amplifiers (EDFL / EDFA) Erbium-doped fiber lasers / amplifiers (EDFL / EDFA) 					
	Optica Other select	l semiconductor lase: ed components and o	r / amplifier (lase levices	r diode)		
2	Learning of Students un tions) of the	ojectives derstand concepts, ba most important pass	asics of physics, de sive and active cor	esign criteria and sy nponents of optical	ystem requirements (communications.	component specifica-
3	Recommen etit 1 + 2, P	ded prerequisites fo hysics	or participation			
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)					
7	Usability of B.Sc. etit, M WI-etit	the module I.Sc. etit - SAE, M.So	c. WI-etit, M.Sc. o	etit - KTS, M.Sc. iC	E, B.Ed. etit, B.Sc.	und M.Sc. iST, B.Sc.
8	Grade bonu	is compliant to $\S{25}$	(2)			

9	References Lecture slides				
	Textbook (M. Cv	ijetic, I. B. Djordjevic: "Advanced Optical Communication Syst	ems and Networks")		
Co	urses				
	Course nr.Course name18-pr-1050-vlOptical Communications - Components				
	Instructor Prof. Dr. rer. nat.	Sascha Preu	Type Lecture	SWS 3	
	Course nr.Course name18-pr-1050-ueOptical Communications - Components				
	InstructorTypeSWSProf. Dr. rer. nat. Sascha PreuPractice1				

Module name								
Module nr. Credit		Credit points	Workload	Self-study	Module duration	Module cycle		
18-sm-1010		6 CP	180 h	120 h	1 Term	Summer term		
Language		Module owner						
German			Prof. Dr. rer. nat. Björn Scheuermann					
1	 Teaching content In this class the technologies that make today's communication networks work are introduced and discussed. This lecture covers basic knowledge about communication networks and discusses in detail the physical layer, the data link layer, the network layer and parts of the transport layer. The physical layer, which is responsible for an adequate transmission across a channel, is discussed briefly. Next, error control, flow control and medium access mechanisms of the data link layer are presented. Then the network layer is discussed. It comprises mainly routing and congestion control algorithms. After that basic functionalities of the transport layer are discussed. This includes UDP and TCP. The Internet is thoroughly studied throughout the class. Detailed Topics are: ISO-OSI and TCP/IP layer models Tasks and properties of the physical layer Physical layer coding techniques Services and protocols of the data link layer Flow control (sliding window) Applications: LAN, MAN, High-Speed LAN, WAN Services of the network layer Routing algorithms Broadcast and Multicast routing Congestion Control Addressing Internet protocol (IP) Internet working Services and protocols of the transport layer The addressing Mobile networking Services and protocols of the transport layer 							
2	Learning objectives This lecture teaches about basic functionalities, services, protocols, algorithms and standards of network commu- nication systems. Competencies acquired are basic knowledge about the lower four ISO-OSI layers: physical layer, datalink layer, network layer and transport layer; Furthermore, basic knowledge about communication networks is taught. Attendants will learn about the functionality of today's network technologies and the Internet.							
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 							
5	Prerequisite for the award of credit points Passing the final module examination							
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of the module B.Sc. etit, B.Sc. MEC, M.Sc. MEC, M.Sc. WI-etit, M.Sc. CE, B.Sc. CE, M.Sc. MedTec, B.Ed. etit, B.Sc. und M.Sc. iST, B.Sc. WI-etit, M.Sc. etit - VAS							
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8	Grade bonus compliant to §25 (2) Grade improvement is achieved by solving voluntary additional assignments due weekly in writing during the lecture period. The maximum grade improvement is 1.0. For a grade improvement to be awarded, a minimum number of points (50% of the maximum achievable points) must be reached. Above this minimum number, the grade improvement increases proportionally (from 0.0 grade improvement at the minimum number to a maximum of 1.0 grade improvement at 95% of the maximum achievable points). Above 95% of the maximum achievable points, the bonus is 1.0. Components of the additional assignments can be classical exercises, answering quizzes, creating wiki articles or quizzes. Participation in these is mandatory to receive the grade improvement. The grade improvement has no influence on passing the exam.							
9	References Selected chapter • Andrew S. • Andrew S. • Larry L. Pet Publishers, • Larry L. Pet Verlag, 200 • James F. Ku Edition, Pe • James F. Ku 2014 • R. Srikant, Morgan & • • Olivier Bo https://ww	s from the following sources: Tanenbaum: Computer Networks, 5th Edition, Prentice Hall, 2 Tanenbaum: Computernetzwerke, 5. Auflage, Pearson Studium erson, Bruce S. Davie: Computer Networks: A Systems Approach 2021 terson, Bruce S. Davie: Computernetze: Eine systemorientierte trose, Keith W. Ross: Computer Networking: A Top-Down Appro arson, 2021 trose, Keith W. Ross: Computernetzwerke: Der Top-Down-Appro arson, 2021 trose, Keith W. Ross: Computernetzwerke: Der Top-Down-Ansa Jean Walrand, Shyam Parekh: Communication Networks: A Co Claypool, 2017 naventure: Computer Networking: Principles, Protocols tw.computer-networking.info	2010 n, 2012 , 6th Edition, Morgan Ka Einführung, 4. Auflage, oach Featuring the Inter tz, 6. Auflage, Pearson S oncise Introduction, 2nd s and Practice, open	ufmann Dpunkt net, 8th ctudium Edition, ebook,				
Co	urses							
	Course nr. 18-sm-1010-vl	Course name Communication Networks I						
	Instructor Prof. Dr. rer. nat.	Björn Scheuermann	Type Lecture	SWS 3				
	Course nr. 18-sm-1010-ue	Course name Communication Networks I						
	Instructor Prof. Dr. rer. nat.	Björn Scheuermann	Type Practice	SWS 1				

Mo Log	dule name gic Design						
Mo 18-	dule nr. sm-1040	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration	Module cy Winter terr	cle n
Lar Ger	iguage man	I	I	Module owner Prof. Dr. rer. nat.	Björn Scheuermann		
1	Teaching co Boolean alg -tables, tech	ontent ebra, logic gates, har nology mapping, pro	dware description grammable logic o	languages, flipflog circuits	os, sequential circuits	, state-diagra	ims and
2	 Learning objectives By this module, Students will be enabled to 						
3	Recommended prerequisites for participation						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 						
5	Prerequisite Passing the	e for the award of c final module examination	redit points ation				
6	Grading Module exa • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. etit, B	the module Sc. MEC, B.Sc. CE, I	3.Sc. iST, B.Ed. et	it, B.Sc. WI-etit			
8	Grade bonu	is compliant to §25	(2)				
9	References David Harris	s und Sarah Harris: I	Digital Design and	Computer Archite	cture		
Co	ırses						
	Course nr. 18-sm-1040	-vl Logic Design					
	Instructor Prof. Dr. rer.	nat. Björn Scheuerr	nann		Type Lecture		SWS 3
	Course nr. 18-sm-1040	-ue Logic Design			·		
	Instructor Prof. Dr. rer.	nat. Björn Scheuerr	nann, M.Sc. Sebas	stian Rust	Type Practice		SWS 1

Mo Sof	dule name tware Enginee	ring - Introduction						
Mo 18-	dule nr. su-1010	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module 1 Term	duration	Module cyc Winter tern	cle n
Lar Ger	iguage man		1	Module owner Prof. Dr. rer. nat.	Andreas S	Schürr	1	
1	Teaching con The lecture g - as entitled of the indicated the design of Software Eng the course as one object-or to explain an	ntent ives an introduction e.g. by the IEEE's ' depth. Main emph software architectu ineering Code of Et the favored modelin ented programming d exercise the prese	n to the broad dise 'Guide to the Soft asis is laid upon n ares (software des hics and Profession ng language. This g language (prefer ented software eng	cipline of software tware Engineering requirements elicit sign). Ethical issues nal Practice". UML requires the attend ably Java). During gineering technique	engineerin Body of H ation techn s are addro (2.0) is in ees to hav the lecture es.	ng. All maj Knowledge niques (sof essed using ntroduced a e a sound l e, running e	or topics of the set o	he field ssed in sis) and EEE-CS oughout at least utilized
2	2 Learning objectives This lecture aims to introduce basic software engineering techniques - with recourse to a set of best-practice approaches from the engineering of software systems - in a practice-oriented style. After successful completion of the module, students should be able to uncover, collect and document essen- tial requirements with respect to a software system in a systematic manner using a model-based approach. Furthermore, at the end of the course a variety of means to acquiring insight into a software system's design (architecture) should be at the student's disposal.							
3	Recommended prerequisites for participation sound knowledge of an object-oriented programming language (preferably Java)							
4	Form of exam Module exam • Module	nination :: exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., D	efault RS)		
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exam • Module	: exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of t B.Sc. etit, B.S M.Sc. etit - C	t he module Sc. MEC, M.Sc. ME MEE	C, B.Sc. MedTec,	B.Sc. CE, M.Sc. Me	edTec, B.S	c. iST, B.E	d. etit, B.Sc.	WI-etit,
8	Grade bonus Grade improv	compliant to §25 rements up to 0.4 p	(2) er APB 25 (2) du	e to bonus for regu	larly subm	nitted home	ework tasks	
9	References https://www	.es.tu-darmstadt.de	/lehre/aktuelle-ve	eranstaltungen/se-i	-v and Mo	odle		
Cou	ırses							
	Course nr. 18-su-1010-v	Course name l Software Engi	neering - Introduc	tion				
	Instructor Prof. Dr. rer.	nat. Andreas Schür	r			Type Lecture		SWS 3

Course nr. 18-su-1010-ue	Course name Software Engineering - Introduction		
Instructor Prof. Dr. rer. nat.	Andreas Schürr, M.Sc. Maximilian Kratz	Type Practice	SWS 1

Mo	dule name)ata-Based Modelling					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	st-1030	6 CP	180 h	120 h	1 Term	Winter term	
Lan Eng	iguage dish			Module owner Prof. Dr. rer. nat.	Florian Steinke		
1	Teaching co	ontent		1			
	 Data-based modelling (aka machine learning) principles: role of models, different metrics & validation criteria Standard settings & basic methods (deterministic and probabilistic approaches): Regression (k-NN, linear regression / LASSO, deep neural networks) Classification (trees & forests, logistic regression, deep neural networks) Unsupervised learning (k-means, PCA, mixture models, autoencoder) Advanced topics: experiment design, dynamic models Application examples from the electrical engineering domain (energy systems, control & communication tasks) Outlook to probabilistic graphical models as a unifying framework Practical exercises with Python deepen the understanding and support students' skills to independently solve new problems. 						
2	 Learning objectives Students understand the key data-based modelling / machine learning settings and important algorithms for each task. Moreover, the students are able to discover a suitable standard setting of data-based modelling behind many typical applications in the electrical engineering domain. They can then independently apply and adapt standard methods to solve these problems. 						
3	Recommen Mathematic Using Pytho	ded prerequisites fo s I/II/III, Statistics/P n for programming tl	r participation robability Theory, he practical exam	Scientific Comput ples should pose no	ing (etit bases course difficulty.	s)	
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	amination, Exam	ination, Duration:	90 Min., Default RS)		
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation				
6	Grading Module exa • Modul	m: e exam (Technical ex	amination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. etit, M	the module I.Sc. etit - DT, M.Sc. e	etit - EET, B.Sc. C	E, B.Ed. etit, B.Sc.	und M.Sc. iST, B.Sc.	WI-etit	
8	Grade bonu Grade impro appointmen	is compliant to §25 wements up to 0.4 acts and independent v	(2) cording to APB 25 vork on a case stu	(2) through bonus dy.	for regularly attended	d practice/internship	
9	References						
Coι	ırses						

Course nr. 18-st-1030-vl	n r. Course name 30-vl Introduction to Data-Based Modelling				
Instructor Prof. Dr. rer. nat.	Florian Steinke, Prof. Dr. techn. Heinz Köppl	Type Lecture	SWS 2		
Course nr. 18-st-1030-ue	Course name Introduction to Data-Based Modelling				
Instructor Prof. Dr. rer. nat.	Florian Steinke, Prof. Dr. techn. Heinz Köppl	Type Practice	SWS 1		
Course nr. 18-st-1030-pr	Course name Introduction to Data-Based Modelling				
Instructor Prof. Dr. rer. nat.	Florian Steinke, Prof. Dr. techn. Heinz Köppl	Type Lab	SWS 1		

Mo Fur	dule name damentals of	Signal Processing					
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	zo-1030	6 CP	180 h	120 h	1 Term	Summer term	
Lar Ger	iguage man			Module owner Prof. DrIng. Abc	lelhak Zoubir		
1	 Teaching content The course covers the following topics: The basic concepts of stochastic The sampling theorem Discrete-time noise processes and their properties Description of noise processes in the frequency domain Linear time-invariant systems: FIR and IIR filters Filtering of noise processes: AR, MA, and ARMA models The Matched filter The Wiener filter Properties of estimators The method of least squares 						
2	2 Learning objectives After successful completion of the module, students understand the basics of probability theory so that they can apply them to stochastic signals in the course of the lecture. In particular, students will be able to describe stochastic processes in the time and frequency domains and analyze their interaction with linear time-invariant systems. Students know the basic properties of estimators. They are able to design optimal filters and apply the method of least squares to problems.						
3	Recommen	ded prerequisites fo	or participation				
4	Form of exa Module exam • Modul The examin course, the e the beginnin	amination m: e exam (Technical ex ation is a written ex examination will be a ng of the lecture.	xamination, Oral/ am (duration: 12 n oral one (durati	written examinatio 20 minutes). If less on: 30 min.). The	n, Duration: 120 Min than 11 students a type of examination	n., Default RS) re registered for the will be announced at	
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	Grading Module exa • Modul	m: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %)	
7	Usability of B.Sc. etit, B.	the module .Sc. MEC, B.Sc. Med	Tec, B.Sc. CE, B.E	d. etit, B.Sc. und M	I.Sc. iST, B.Sc. WI-et	it	
8	Grade bonu	is compliant to §25	(2)				
9	References						

Lecture notes and slides can be downloaded here:

- http://www.spg.tu-darmstadt.de
- Moodle platform
- Further reading:
 - A. Papoulis: Probability, Random Variables and Stochastic Processes. McGraw-Hill, Inc., third edition, 1991.
 - P. Z. Peebles, Jr.: Probability, Random Variables and Random Signal Principles. McGraw-Hill, Inc., fourth edition, 2001.
 - E. Hänsler: Statistische Signale; Grundlagen und Anwendungen. Springer Verlag, 3. Auflage, 2001.
 - J. F. Böhme: Stochastische Signale. Teubner Studienbücher, 1998.
 - A. Oppenheim, W. Schafer: Discrete-time Signal Processing. Prentice Hall Upper Saddle River, 1999.

Courses

CO	urses			
	Course nr. 18-zo-1030-vl	Course name Fundamentals of Signal Processing		
	Instructor Prof. DrIng. Abdelhak Zoubir		Type Lecture	SWS 3
	Course nr. 18-zo-1030-ue	Course name Fundamentals of Signal Processing		
	Instructor Prof. DrIng. Abdelhak Zoubir		Type Practice	SWS 1

1.2 Labs

Mo Act	dule name uators for Mec	hatronic Systems La	iboratory				
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	bt-1030	5 CP	150 h	105 h	1 Term	Summer te	rm
Lar Ger	iguage man			Module owner Prof. DrIng. Yve	es Burkhardt		
1	 Teaching content Safety instructions; Practical experiments about electrical drive systems and mechatronic actuators: Report preparation (one for each group) for each experiment Individual review of the students' knowledge (individual performance) during and/or at the end of the semester The grading consists of the evaluation of the group performance and the individual performance. 						
2	Learning objectives On completion of the module students will have trained the use of mechanical actors and acquired knowledge in using the actors and measuring them.						
3	Recommended prerequisites for participation Lecture "Elektrische Maschinen und Antriebe" and "Maschinenelemente und Mechatronik 1"						
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) The examination has the form of a Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The twoe of examination will be appropriate in the beginning of the lecture. 						
5	Prerequisite Passing the fi	for the award of canal module examination	redit points ation				
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. MEC, B	the module S.Sc. und M.Sc. iST					
8	Grade bonus	s compliant to §25	(2)				
9	References Detailed text	book with description	on for the perform	ance of the lab tes	ts		
Coi	ırses						
	Course nr. 18-bt-1030-p	r Actuators for N	Mechatronic Syste	ms Laboratory			
	Instructor Prof. DrIng.	Yves Burkhardt			Type Lab		SWS 3
	Course nr. 18-bt-2090-t	Course name Laboratory Bri	efing				
	Instructor DrIng. Björn	n Deusinger, Prof. D	rIng. Yves Burkh	ardt	Type Tutorial		SWS 0

Mo Me	dule name chatronics Wo	rkshop					
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	bt-1050	2 CP	60 h	45 h	1 Term	Every Seme	ester
Lar	iguage			Module owner	~ 11 1		
Ger	rman			Prof. DrIng. Yve	s Burkhardt		
1	Teaching co Im Mechatu förderungsa platine, Bah Workshop en	ontent onik-Workshop fert nlage. Hierzu gilt es nwege und -halteru möglicht den Studie	igen die Studiere die Maßpläne zu ngen) sowohl im rrenden somit wicl	enden selbstständi erfassen und die e Elektroniklabor al htige Einblicke in d	g eine Kugelbahn erforderlichen Komp s auch in der Werks ie Konstruktion und	mit elektrisch onenten (u.a. tatt zu fertige die Modellarl	her Be- . Leiter- en. Der beit.
2	2 Learning objectives After completing the module students have an understanding of construction plans, circuit layout design, practical experience with turning, drilling and milling machines.						
3	Recomment	ded prerequisites fo	or participation				
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture. 						
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. MEC	C, M.Sc. etit - EET	, M.Sc. WI-etit			
8	Grade bonu	s compliant to §25	(2)				
9	 9 References Lecture Notes "Mechatronics Workshop" J. Dillinger et al.: Fachkunde Metall, Europa-Lehrmittel, 2007 U. Tietze, C. Schenk, E. Gamm: Halbleiter-Schaltungstechnik, Springer, 2012 						
Co	urses						
	Course nr.	Course name	Maultahar				
	18-Dt-1050-j	pr Mechatronics	vvorkshop				
	InstructorTypeSWSProf. DrIng. Yves BurkhardtLab1						

Mo Lab	dule name	ol Engineering I					
Mo 18-	dule nr. fi-1020	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration 1 Term	Module cy Summer te	cle rm
Lar Ger	nguage rman			Module owner Prof. DrIng. Rol	f Findeisen		
1	1 Teaching content Using appropriate test benches the students apply controller design methods taught in the basic lecture of control systems. The priority hereby lies in the application of the design methods and the evaluation of the parameters they provide. Additionally, some further topics of the domain of control systems (e.g. automation engineering, data-driven modelling) are presented by practical Experiments.						
2	2 Learning objectives After completion of this module the students will be able to practically apply the modelling and design techniques for different dynamic systems presented in the module "System dynamics and control systems I" to real lab experiments and to bring them into operation at the lap setup.						
3	B Recommended prerequisites for participation System Dynamics and Control Systems I						
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, p/np RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture 						
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation				
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. etit	- EET, M.Sc. WI-e	tit, B.Ed. etit, B.Sc.	und M.Sc. iST, B.Sc	. WI-etit	
8	Grade bonu	s compliant to §25	(2)				
9	References Lab handout	s will be given to stu	ıdents.				
Co	urses	1					
	Course nr. 18-ko-1020-	pr Laboratory Co	ntrol Engineering	I			
	Instructor Prof. DrIng	Ulrich Konigorski			Type Lab		SWS 4

Mo Lab	dule name oratory Matla	ıb/Simulink I						
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
Lar	nguage rman	5.01	70 H	Module owner Prof. DrIng. Rol	f Findeiser	1	Every Senie	.5101
1	1 Teaching content In this lab tutorial, an introduction to the software tool MatLab/Simulink will be given. The lab is split into two parts. First the fundamentals of programming in Matlab are introduced and their application to different problems is trained. In addition, an introduction to the Control System Toolbox will be given. In the second part, the knowledge gained in the first part is applied to solve a control engineering specific problem with the software tools.							
2	Learning ol Fundamenta	jectives Ils in the handling of	Matlab/Simulink	and the applicatio	n to contro	ol engineer	ring tasks.	
3	Recommended prerequisites for participation The lab should be attended in parallel or after the lecture "System Dynamics and Control Systems I"							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) 							
5	Prerequisite for the award of credit points Passing the final module examination							
6	Grading Module exa • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B WI-etit	the module .Sc. MEC, M.Sc. eti	t - EET, B.Sc. Mee	dTec, M.Sc. MedTe	ec, B.Ed. e	etit, B.Sc.	und M.Sc. iS	T, B.Sc.
8	Grade bonu In case of E-	s compliant to §25 Learning: Possibility	(2) to improve the gr	ade up to 1,0				
9	 References Lecture notes for the lab tutorial can be obtained at the secretariat Lunze; Regelungstechnik I Dorp; Bishop: Moderne Regelungssysteme Moler: Numerical Computing with MATLAB 							
Co	ırses							
	Course nr. 18-fi-1030-p	or Course name Laboratory Ma	atlab/Simulink I					
	Instructor Prof. DrIng	. Rolf Findeisen, M.S	Sc. Alexander Stei	nke, M.Sc. Sebastia	an Hirt	Type Lab		SWS 3

Mo	dule name							
Dig	ital Design Lab		1	1	I	1		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle	
18-	nd-1030	3 CP	90 h	00 n	1 Ierm	Summer ter	rm	
Lar Ger	iguage man			Prof Dr-Ing Chr	istian Hochberger			
1	Teaching cor	itent						
	 Introduction to the MP3 encoding standard for audio signals Analysis of the individual steps of the decoding process wrt. the used algo-rithms Analysis of the individual steps of the decoding process wrt. the storage of in-termediate results Design and configuration of the datapath to realize the individual process steps Simulation on functional level and with timing annotation Check, whether the design meets all restrictions Test of the final HW design with all relevant MP3 variants (short and long frames) 							
2	Learning objectives After successfully completing the module, students will be able to map complex processes onto a digital target architecture by hand. They master the tools for implementing their solution on an FPGA. They know strategies to systematically search for errors. They can explore a design through simulation.							
3	Recommend Basic knowled	ed prerequisites for lge of digital design	or participation					
4	Form of exar Module exam • Module	nination : exam (Study achie	vement, Oral exa	nination, Duration	: 15 Min., Default RS	3)		
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation					
6	Grading Module exam • Module	: exam (Study achie	vement, Oral exa	nination, Weightin	g: 100 %)			
7	Usability of t B.Sc. etit, B.S	he module c. und M.Sc. iST, B	S.Sc. WI-etit					
8	Grade bonus	compliant to §25	(2)					
9	References							
Co	1 rses							
	Course nr. 18-hb-1030-r	r Digital Design	Lab					
	18-hb-1030-prDigital Design LabInstructorTypeProf. Dr. Ing. Christian HochbergerLab2					SWS 2		

Mo Ele	dule name ctronics Lab						
Mo	dule nr. ho-1031	Credit points	Workload 90 h	Self-study	Module duration	Module cy Winter term	cle
Lar Ger	nguage man	0.01		Module owner Prof. DrIng. Klaus Hofmann			
1	 Teaching content Students conduct lab experiments on: Electronic components: diodes, transistors, integrated circuits Analog circuits: operational amplifiers, active and passive filters, modelling and simulation with SPICE, discrete transistor amplifiers and output stages Digital circuits: discrete digital logic, state machines, HDL programming, EDA tools for FPGAs 						
2	 Learning objectives After completing the module successfully students are able to conduct measurements on analog and digital circuits in a lab setting comprehend how a complex electronic system is assembled from basic circuit blocks to design a state machine and implement in a hardware description language on an FPGA 						
3	3 Recommended prerequisites for participation Basics of Electrical Engineering; Lecture "Electronics" which is running in parallel						
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, p/np RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in 						
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. iST, I	B.Ed. etit, B.Sc. W	/I-etit			
8	Grade bonu	s compliant to §25	(2)				
9 Co1	References Slide Copies 1rses	of Lecture "Electron	ics"; Paul Horowit	z and Winfried Hil	l, "The Art of Electro	nics"	
	Course nr. 18-ho-1031-	pr Electronics La	b				
Is-no-1031-prElectronics LabInstructorTypeProf. DrIng. Klaus HofmannLecture					SWS 2		

Course nr. 18-ho-1030-ev	Course name Electronics Lab - Introductory Meeting		
Instructor Prof. DrIng. Kla	us Hofmann	Type Introductory course	SWS 0

Mo HD	dule name L Lab						
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	ho-1090	- 6 CP	180 h	135 h	1 Term	Summer te	rm
Lar Eng	iguage ;lish			Module owner Prof. DrIng. Klat	ıs Hofmann		
1	Teaching co Realisation o	ontent of a VHDL- or Verilog	-based VLSI Syste	em Design Project i	n a Team with indust	trial constrain	ıts
2	2 Learning objectives A student is, after successful completion of this module, able to						
	 design, optimize and verify a complex digital system (e.g. a pipelined CPU or signal processor) using Verilog or VHDL, synthesize the HDL description using commercial CAD software to a gate level description After successful completion of this module the students are able to work constructively on a feasible solution. Aside, they are able to mutually support each other and present intermediate results to peers, and achieve an overall feasible solution. 						
3	Recommended prerequisites for participation Lecture Computer Aided Design for System on Chips, At least one high-level Programming Language, Basic Know-How Linux/Unix, Computer Architectures						
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture 						
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)		
7	Usability of B.Sc. MEC, I	the module M.Sc. etit - DT, M.Sc	. etit - SAE, M.Sc.	WI-etit, M.Sc. iCE	B.Sc. und M.Sc. iST	.	
8	Grade bonu	s compliant to §25	(2)				
9	9 References Lecture slides "CAD4SoC"						
Coi	ırses						
	Course nr. 18-ho-1090-	pr HDL Jab					
	18-ho-1090-pr HDL Lab Instructor Type SWS Prof. DrIng, Klaus Hofmann Lab 3					SWS 3	

Mo	dule name	chnology I ab					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	kn-1031	3 CP	90 h	60 h	1 Term	Summer term	
Lan Ger	iguage man			Module owner Prof. Dr. Mario Ki	upnik		
1	Teaching co	ontent					
	 Measuring signals in the time domain using digital storage oscilloscopes, trigger constraints Measuring signals in the frequency domain using digital storage oscilloscopes, measuring errors (aliasing/under sampling, leackage) and window functions Measuring mechanical quantities with appropriate sensors, sensor electronics/amplifier circuits Computer-based measurements and ultrasound sensors Read and process sensor signals and control an automated process using a programmable logic controller (PLC) First experiments with robotic and medical robots for insertion of needles 						
2	2 Learning objectives After having successfully completed the course participants are familiar with the use of measuring devices, sensors and electronics. They know about restrictions and possible measuring errors. Also, participants enhance their knowledge of time- and frequency-domain and the connections between both by the oscilloscope measurements. Regarding methodical skills participants are able to record measurement results during laboratory work and to interpret the measured data afterwards.						
3	Recommended prerequisites for participation Electrical Engineering and Information Technology I and II						
4	 Electrical Engineering and Information Technology I and II Form of examination Module exam: Module exam: Module exam (Study achievement, Oral/written examination, p/np RS) The examination has the form of a Report (including submission of programming code) and/or a Presentation and/or an Oral examination and/or a Colloquium (testate). The type of examination will be announced in the basing of the leature 						
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation				
6	Grading Module exa • Modul	m: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. Med	Tec, B.Sc. CE, B.E	d. etit, B.Sc. und M	I.Sc. iST, B.Sc. WI-et	it	
8	Grade bonu	is compliant to §25	(2)				
9	References						
	 Script of the practical course Lerch, Reinhard: Elektrische Messtechnik : Analoge, digitale und computergestützte Verfahren. 5. neu bearbeitete Auflage. Berlin: Springer, 2010 ISBN 978-3642054549 						
Coι	ırses						

Course nr. 18-kn-1031-pr	Course name Measuring Technique Lab		
Instructor Prof. Dr. Mario K	upnik	Type Lab	SWS 2

34-	4					
Ele	ctrical Engine	ering and Informatio	n Technology Lab	Ι		
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	kn-1041	4 CP	120 h	60 h 2 Term Winter term		
Lar Ger	iguage rman			Module owner Prof. Dr. Mario K	upnik	
1	Teaching co After a safet engineering up a test set theoretical k The followir Investi Calcul Measu	ontent y instruction for elect by using theoretical an autonomously and p mowledge and lead to ag experiments are per igate real behavior of agate real behavior of ate impedances of ba re of electrical power	rical equipment, s nd experimental ir erforming of meas o independent wo erformed: cohmic resistors capacitors and in sic two-terminal or r in AC circuits an	students dolab expension nstructions to impro surements and eval ork in practice. ductors circuits using netwo d investigate in the	eriments covering fou ve basic electrical und uations in the form c ork theory e real behaviour of tra	ndations of electrical lerstanding. Building of logs to confirm the ansformers
2	Learning ol Upon succes	ojectives ssful completion of th	e module, studen	ts will be able to:		
	 perform the measurement of basic electrical parameters of DC and AC circuits, independently and in compliance with safety rules measuring the frequency response of passive electrical networks and resonant circuits, and electric power measurement the measurement of circuits for the determination of magnetic, electro-thermal and high-frequency. You have to be able to build and run your own measurements interpretations of the measurement results in terms of its technical meaning, but also their accuracy and error sources safely work together in internship groups To prepare measurement protocols in detail 					
3	Recommen Parallel atte	ded prerequisites fo nding the lectures an	r participation d exercises, "Elec	trical Engineering I	and II"	
4	Form of exa Module exa • Modul Report (inclu and/or Collo the beginnin	amination m: e exam (Study achieu uding submission of p oquium (testate), but ng of the lecture.	vement, Oral/writ programming code never more than	tten examination, p) and/or Presentati two out of it. The t	o/np RS) on and/or Oral exam ype of examination v	ination (25 minutes) will be announced in
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation			
6	 Grading Module exam: Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 					
7	Usability of the module B.Sc. etit, B.Sc. MEC, B.Sc. MedTec, B.Sc. iST, B.Ed. etit, B.Sc. WI-etit					
8	Grade bonu	is compliant to §25	(2)			

9	References Detailed script with instructions for the experiments; Clausert, H. / Wiesemann, G.: Grundgebiete der Elek- trotechnik, Oldenbourg,1999						
Co	urses						
	Course nr.Course name18-kn-1040-prElectrical Engineering and Information Technology Lab I A						
	Instructor Prof. Dr. Mario K	upnik	Type Lab	SWS 2			
	Course nr. 18-kn-1041-pr	Course name Electrical Engineering and Information Technology Lab I B					
	Instructor Prof. Dr. Mario K	upnik	Type Lab	SWS 2			
	Course nr. 18-kn-1040-tt	instructions and rules					
	Instructor Prof. Dr. Mario K	upnik	Type Tutorial	SWS 0			

Mo Lab	dule name	omedical Engineering	5					
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
18-	kp-1050	2 CP	60 h	30 h	1 Term		Winter tern	n
Lar Ger	nguage rman			Module owner Prof. Dr. techn. H	leinz Köppl	l		
1	Teaching co This module current topi radiotherap	ontent e addresses the diffe cs of biomedical engi y, imaging techniques	rent branches of l neering like medic s, biosignal-monite	piomedical engined cal robotics, measur pring, gerontology	ering. Cont ring and ser or Lab-on-a	ents of la nsor techr a-Chip.	b experiment tology, biome	ts cover chanics,
2	2 Learning objectives After successful completion of this module students will be familiar with practical applications of medical engineering and have learnt to identify necessary practical methods and work techniques and to implement them correctly. They will also have gained experience in experimental works in autonomous small groups from a medical engineering context.							
3	3 Recommended prerequisites for participation "Electrical Engineering and Information Technology I", and "Electrical Engineering and Information Technology II"							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, p/np RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture 							
5	Prerequisit Passing of M	e for the award of c Iodule final exam	redit points					
6	Grading Module exa • Modul	m: le exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. MedTe	the module						
8	Grade bonu	is compliant to §25	(2)					
9	References							
Co	Courses							
	Course nr.Course name18-kp-1050-prLaboratory of Biomedical Engineering							
	InstructorTypeSWSProf. DrIng. Jürgen Adamy, Prof. DrIng. Klaus Hofmann, Prof. DrIng. Abdelhak Zoubir, Prof. Dr. techn. Heinz Köppl, M.Sc. Mengguang Li, Prof. Ph.D.Lab2							

Course nr. 18-kp-1050-tt	Course name Preliminary		
Instructor Prof. Dr. techn. H	leinz Köppl	Type Preliminary discus-	SWS 0
		sion	

Mo Sof	dule name tware Lab Fin	ite Integration Tech	nique					
Mo 18-	dule nr. sc-1010	Credit points 8 CP	Workload 240 h	Self-study 165 h	Module d	luration	Module cy Summer te	cle rm
Lar Ger	nguage man			Module owner Prof. Dr. rer. nat. Sebastian Schöps				
1	Teaching content Various topics are: 1. Introduction 2. Basics of FIT I 3. Basics of FIT II 4. Static problems (electrical/magnetical) (scalar potential) 5. Magnetostatic problems, frequency domain 6. Time domain integration techniques: Leapfrog I 7. Time domain integration techniques: Leapfrog II 8. Other physical problems: heat conduction 9. Other discretization methods: Finite Element Method.							
2	Learning objectives Students will understand basic concepts of numerical solution techniques to field problems related to different physical domains. They will exhibit the ability to write small simulation programs.							
3	Recommended prerequisites for participation Finite Integration Technique (18-dg-1030), also parallel participation possible.							
4	Form of exa Module exar • Modul Report (inclu and/or Collo the beginnin	mination n: e exam (Study achie Iding submission of p oquium (testate), but ng of the lecture.	vement, Oral/wri programming code t never more than	tten examination, I) and/or Presentati two out of it. The r	Default RS) ion and/or type of exa) Oral exam mination v	ination (25 n will be annou	ninutes) Inced in
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. CE						
8	Grade bonu	s compliant to §25	(2)					
9	References Course notes	s will be provided via	a Moodle.					
Cot	urses Course pr	Course name						
	18-sc-1010-j	pr Software Lab	Finite Integration	Technique				
	Instructor Prof. Dr. rer.	nat. Sebastian Schö	ps			Type Lab		SWS 5

Mo	dule name tware Lab Sci	entific Computing						
Mo 18-	dule nr. sc-1030	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cy Summer te	cle rm	
Lar Ger	iguage man			Module owner Prof. Dr. rer. nat. Sebastian Schöps				
1	Teaching co Numerical a methods, no value/eigenv	ntent lgorithms: numerica onlinear systems of rector computation.	l solution of linea equations, initial	r systems of equati value problem fo	ions, interpolation, n r ordinary differenti	umerical qua	drature , eigen-	
2	Learning of After completimplemented	jectives tion of the module, a d and automatically	fundamental algoi tested in software	rithms of numerics by the students.	are understood and o	can be protot	ypically	
3	Recommend Mathematics	led prerequisites fo 3 1, Mathematics 2, 1	or participation Mathematics 3 (in	parallel)				
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, p/np RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)			
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. iST, 1	B.Ed. etit					
8	Grade bonu	s compliant to §25	(2)					
9	References							
Coi	Courses							
	Course nr.Course name18-sc-1030-prSoftware lab scientific computing							
	InstructorTypeSWSProf. Dr. rer. nat. Sebastian SchöpsLab2					SWS 2		

Mo	dule name							
Mu	ltimedia Com	munications Lab I						
Mo 18-	dule nr. sm-1020	Credit points 3 CP	Workload 90 h	Self-study 45 h	Module duration 1 Term	Module cycle Every Semester		
Lar Ger	nguage rman/English			Module owner Prof. DrIng. Ral	f Steinmetz			
1	 Teaching content The course deals with cutting-edge development topics in the area of multimedia communication systems. Besides a general overview, it provides a deep insight into a special development topic. The topics are selected according to the specific working areas of the participating researchers and convey technical and basic scientific competencies in one or more of the following topics: Network planning and traffic analysis Performance evaluation of network applications							
2	Learning of The ability competence • Design • Impler • Applic • Preser	ojectives to solve simple prob s are: n of simple communic menting and testing of ation of object-orient tation of project adva	lems in the area of cation applications of software compo- red analysis and d ances and outcom	of multimedia com s and protocols onents for distribute esign techniques tes	nmunication shall be ed systems	acquired. Acquired		
3	Recommen Keen interes expect: • Basic e • Knowl Centri	ded prerequisites for st to explore basic top experience in programed ge in computer co c Systems are recomm	or participation bics of cutting edg nming Java/C# ((ommunication net nended.	e communication a C/C++). works. Lectures in	and multimedia tech Communication Ne	nologies. Further we tworks I and/or Net		
4	Form of exa Module exa • Modul Report (inclu- and/or Colle the beginnin	amination m: e exam (Study achie uding submission of p oquium (testate), but ng of the lecture.	vement, Oral/writ programming code never more than	tten examination, I) and/or Presentati two out of it. The t	Default RS) on and/or Oral exam type of examination v	ination (25 minutes) will be announced in		
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation					
6	Grading							

	Module exam:Module exam (Study achievement, Oral/written examination, Weighting: 100 %)						
7	Usability of the module B.Sc. etit, M.Sc. MEC, M.Sc. MedTec, B.Sc. und M.Sc. iST, B.Sc. WI-etit						
8	Grade bonus compliant to §25 (2)						
9	 References Each topic is covered by a selection of papers and articles. In addition we recommend reading of selected chapters from following books: Andrew Tanenbaum: "Computer Networks". Prentice Hall PTR (ISBN 0130384887) Christian Ullenboom: "Java ist auch eine Insel: Programmieren mit der Java Standard Edition Version 5 / 6" (ISBN-13: 978-3898428385) Kent Beck: "Extreme Programming Explained - Embrace Changes" (ISBN-13: 978-0321278654) 						
Coi	ırses						
	Course nr.Course name18-sm-1020-prMultimedia Communications Lab I						
	InstructorTypeSWSProf. Dr. rer. nat. Björn Scheuermann, Dr. Ing. Julian Zobel, M.Sc. FridolinLab3Siegmund, Prof. DrIng. Ralf Steinmetz11						

Mo Sof	dule name tware Lab							
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
Lar Ger	nguage man		120 11	Module owner Prof. Dr. rer. nat.	Florian S	teinke	winter term	
1	 Teaching content The lab course covers the following basic software development skills: Knowledge of the programing language Java (syntax, underlying concepts, conventions) Use of a development environment (Eclipse) Software documentation using JavaDoc Systematic testing with JUnit Software development in teams (incl. use of git) Introduction to data structures and algorithms, first complexity analyses These topics are developed in conjunction with a game that models the renewable electricity supply of islands. Students participating in the lab deepen their basic programming knowledge (acquired in Computer Science for Engineers). The focus is on development of "medium-size" software in contrast to programming small toy examples, working in teams, and the development in conjunction with an existing software framework. 							
2	Learning objectives Upon completion of the module, students have acquired the ability to collaborate in a team and to systematically develop a given software system (framework). They have the skills to implement, test and document smaller software systems and have an understanding of the need to use comprehensive software engineering techniques for the development of large software systems.							
3	Recomment Basics in Jav	ded prerequisites fo ra (as taught in Intro	or participation duction to Compu	ter Science for Eng	ineers).			
4	Form of exa Module exa • Modul Report (incl minutes) an announced i	mination n: e exam (Study achie uding submission of d/or a Colloquium (n the beginning of tl	vement, Oral/wri programming co (testate), but neve ne lecture.	tten examination, p de) and/or a Prese er more than two o	o∕np RS) ntation ai ut of it. T	nd/or an O 'he type of	ral examinat examination	ion (25 will be
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting	: 100 %)		
7	Usability of B.Sc. etit, M	the module .Sc. MEC, B.Ed. etit,	B.Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References http://www	.eins.tu-darmstadt.d	e/teaching/course	es/software-praktik	um			
Coι	ırses							
	Course nr. 18-st-1020- ₁	or Course name Software Lab				1		
	Instructor Prof. Dr. rer.	nat. Florian Steinke	. M.Sc. Kirill Kuro	optev. M.Sc. Julia B	arbosa	Type Lab		SWS

Mo	dule name	ming I ab							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cvcle			
18-	fi-1040	3 CP	90 h	60 h	1 Term	Summer term			
Lar Ger	n guage man			Module owner Prof. Dr. rer. nat. Andreas Schürr					
1	 Teaching content The programming lab is divided into two parts. In the first part of the lab, the basic concepts of the programming languages C and C++ are taught during the semester through practical exercises and presentations. All aspects will be deepened by extended practical exercises in self-study on the computer. For this purpose, all necessary materials such as presentation slides, presentation recordings, exercises, sample solutions of the exercises and recordings of the exercise discussions are provided in purely digital form. The second part of the lab is about programming a microcontroller using the C programming language. For this purpose, the students are provided with a microcontroller for two days, with which they can work on practical programming tasks under supervision. The following topics will be covered in the course: Basic concepts of the programming languages C and C++ Memory management and data structures Object oriented programming in C++ (Multiple) Inheritance, polymorphism, parametric polymorphism (Low-level) Programming of embedded systems with C Learning objectives 								
2	2 Learning objectives During the module, students acquire basic knowledge of C and C++ language constructs. Additionally, they learn how to handle both the procedural and the object-oriented programming style. Through practical programming exercises, students acquire a feeling for common mistakes and dangers in dealing with the language, especially in the development of embedded system software, and learn suitable solutions to avoid them. Furthermore, through handle are empiring and the development of embedded system software, and learn suitable solutions to avoid them.								
3	Recommen Java skills	ded prerequisites fo	or participation						
4	Form of exa Module exam • Modul The examina and/or an O From a num exam (durat	mination m: e exam (Study achiev ation has the form of Oral examination (25 iber of 10 students re- cion: 90 minutes). Th	vement, Oral/wri a Report (includi minutes) and/or egistered for the c ae type of examina	tten examination, I ng submission of p a Colloquium (tes ourse, the examina ation will be annou	Default RS) rogramming code) at state), but never mor ation may take place nced in the beginnin	nd/or a Presentation re than two out of it. in form of a written og of the lecture.			
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation						
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)				
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. MEC	C, B.Sc. MedTec, M	I.Sc. MedTec, B.Sc	. und M.Sc. iST, B.Sc	c. WI-etit			
8	Grade bonu	is compliant to §25	(2)						

	Grade improvem submitted bonus The content of th Oriented Program each, which mus Bonus credit is gi Total bonus = 1.	ents up to 1.0 according to APB 25(2) can be achieved throug assignments. e course is divided into 5 topics. For each topic (Fundamentals nming, Advanced Concepts, and C) there is one assignment sh t be solved and handed in by the students. The assignment is ven in proportion to the ratio of passed bonus tasks and the to $0 \times$ Number of passed tasks / Total number of bonus tasks	gh a bonus system for re s, Memory Management, leet with one bonus assi s considered either pass otal number of bonus tas	gularly , Object gnment s or fail. sks.				
9	ReferencesA recording of the presentations as well as presentation slides are available in the corresponding Moodle course.Additional literature:• Schellong, Helmut: Moderne C Programmierung, 3. Auflage. Springer, 2014• Schneeweiß, Ralf: Moderne C++ Programmierung, 2. Auflage. Springer, 2012• Stroustrup, Bjarne: Programming - Principles and Practice Using C++, 2nd edition. Addison-Wesley, 2014• Stroustrup, Bjarne: A Tour of C++, 2nd edition. Pearson Education, 2018							
Co	urses							
	Course nr.Course name18-fi-1040-prC/C++ Programming Lab							
	InstructorTypeSWSProf. DrIng. Rolf Findeisen, Prof. Dr. rer. nat. Andreas SchürrLab2							

1.3 Seminars

Mo Ser	Module name Seminar Electronic Circuits								
Mo 18-	dule nr. ho-1070	Credit points 4 CP	Workload 120 h	Self-study 90 h	Module 1 Term	duration	Module cyc Every Seme	c le ester	
Lar Ger	n guage man			Module owner Prof. DrIng. Kla	us Hofman	ın			
1	Teaching co Analysis of s	ntent tate-of-the-art circui	t concepts and pre	esentation of select	ed exampl	es			
2	Learning ob After attendididactical ma Integrated C	jectives ng the seminar, a st aterials and present <i>a</i> ircuit Design"	udent is capable o ations, based on th	f analysing of state e know-how gained	of-the-art in the lec	circuit con tures "Elec	cepts and protocols and '	eparing "Analog	
3	Recommended prerequisites for participation Electronics, Electronic and Integrated Circuits								
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 30 Min., Default RS) 								
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation						
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral exa	nination, Weightin	g: 100 %)				
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit							
8	Grade bonu	s compliant to §25	(2)						
9	References Will be prov	ided at the begin of	the seminar						
Coi	urses								
	Course nr. 18-ho-1070-	se Seminar Elect	ronic Circuits						
	Instructor Prof. DrIng	. Klaus Hofmann				Type Seminar		SWS 2	

1.4 Modules Scientific working and writing

Mo Scie	dule name entific Workin	g and Writing						
Mo 18-	dule nr. ad-1001	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module	duration	Module cyc Every Seme	c le ester
Lar Ger	n guage man/English		I	Module owner Prof. DrIng. Jürg	gen Adam	у		
1	 Feacing content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	Learning ob The students and present it in writing	jectives s are able to comprel them in a structured and refer to its conto	nend and analyze manner. Using the ents.	scientific texts, pre e example of an ori	sent techn ginal work	ical facts i , they can	n an orderly i correctly sum	manner 1marize
3	Recommended prerequisites for participation							
4	Form of exa Module exar • Module Report and/ announced a	mination n: e exam (Study achie or term paper and/o at the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS e thesis). T) The type of	examination	will be
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. Med	Tec, B.Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	ırses							
	Course nr. 18-ad-1001-	ps Course name Scientific work	king and writing					
	Instructor Prof. DrIng	. Jürgen Adamy				Type Introduct course	ory seminar	SWS 2

Mo	dule name	1 147 1.1						
Scie	entific Workin	g and Writing		- 10 1			• •	
1 MO	dule nr.	Credit points	Workload	Self-study	1 Torm	duration	Module cyc	cle
Lar		5 Cr	90 II	Module owner	1 ICIIII		winter term	1
Ger	man			Prof. Dr. Oliver B	oine-Frank	kenheim		
1	 I leaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	3 Recommended prerequisites for participation							
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS e thesis). T) The type of	examination	will be
5	Prerequisite Passing the f	e for the award of c inal module examination	redit points ation					
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 18-bf-1001-p	Scientific work	king and writing					
	Instructor Prof. Dr. Oliv	er Boine-Frankenhe	im			Type Introduct course	ory seminar	SWS 2

Mo	dule name								
Sci	entific Workin	g and Writing							
	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle	
18-	DL-1001	3 CP	90 11		1 Ierm		Every Seme	ester	
Ger	rman/English			Prof. DrIng. Yve	s Burkhard	dt			
1	 Teaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 								
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.								
3	3 Recommended prerequisites for participation								
4	Form of exa Module exar • Modul Report and/ announced a	mination n: e exam (Study achie or term paper and/o it the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be	
5	Prerequisite Passing the f	e for the award of c	redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of B.Sc. etit, B.	the module Ed. etit, B.Sc. WI-et	it						
8	Grade bonu	s compliant to §25	(2)						
9	References								
Cot	urses								
	Course nr. 18-bt-1001-j	Course name Scientific work	king and writing						
	Instructor Prof. DrIng	Yves Burkhardt				Type Introduct course	ory seminar	SWS 2	

Mo	dule name								
Scie	entific Workin	g and Writing	1	1			1		
Mo	dule nr.	Credit points	Workload	Self-study	Module of	duration	Module cyc	cle	
18-	bu-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester	
Lar Ger	nguage man/English			Module owner Prof. Ph.D. Thom	as Burg				
1	 Teaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 								
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.								
3	3 Recommended prerequisites for participation								
4	Form of exa Module exar • Module Report and/ announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be	
5	Prerequisite Passing the f	e for the award of c inal module examinat	redit points ation						
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of B.Sc. etit, B.	the module Sc. MedTec, B.Ed. e	tit, B.Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)						
9	References								
Coi	urses								
	Course nr. 18-bu-1001-	ps Course name Scientific work	king and writing						
	Instructor Prof. Ph.D. T	homas Burg				Type Introduct course	ory seminar	SWS 2	

Mo	dule name	and Writing								
Mo	dule nr	Credit points	Workload	Self-study	Module	duration	Module cvo			
18-	dg-1001	3 CP	90 h	60 h	1 Term	auration	Every Seme	ester		
Lar Ger	n guage rman/English			Module owner Prof. DrIng. Herbert De Gersem						
1	 Teaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 									
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.									
3	3 Recommended prerequisites for participation									
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be		
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation							
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)				
7	Usability of B.Sc. etit	the module								
8	Grade bonu	s compliant to §25	(2)							
9	9 References									
Coi	urses									
	Course nr. 18-dg-1001-	ps Course name Scientific worl	king and writing							
	Instructor Prof. DrIng.	Herbert De Gersem	1			Type Introduct course	ory seminar	SWS 2		

Mo	dule name	1 1							
Sci	entific Workin	g and Writing							
	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle	
18-	11-1001	3 CP	90 h		1 Ierm		Every Seme	ster	
Ger	nguage man/English			Prof. DrIng. Rol	f Findeiser	ı			
1	 Teaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 								
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.								
3	8 Recommended prerequisites for participation								
4	Form of exa Module exar • Modul Report and/ announced a	mination n: e exam (Study achie or term paper and/o ut the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be	
5	Prerequisite Passing the f	e for the award of c	redit points ation						
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)			
7	Usability of B.Sc. etit, B.	the module Sc. MedTec, B.Sc. W	Л-etit						
8	Grade bonu	s compliant to §25	(2)						
9	References								
Co	urses								
	Course nr. 18-fi-1001-p	s Scientific work	king and writing						
	Instructor Prof. DrIng	. Rolf Findeisen				Type Introduct course	ory seminar	SWS 2	
Mo Scie	dule name entific Workin	g and Writing							
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Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle			
18-	fr-1001	3 CP	90 h	60 h	1 Term	Winter term			
Lar Ger	iguage man/English			Module owner Prof. Dr. habil. To	orsten Frosch				
1	Teaching co Content and Elabor Detaile Deeper Practic Learni Presen	ontent d goals ation of a technical t ed study of technical r understanding of tl cal experience with to ng modern presenta tation and discussion	copic in cooperatio articles he technical topic echnical documen tion techniques an n of the technical	n with a research a treated therein tation d their application topic in front of a g	associate as superviso group of people	Dr			
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.								
3	B Recommended prerequisites for participation								
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or term paper and/or presentation (in preparation for the thesis). The type of examination will be announced at the beginning of the course 								
5	Prerequisite Passing the f	e for the award of c	redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Weighting: 100 %)				
7	Usability of B.Sc. MedTe	the module							
8	Grade bonu	s compliant to §25	(2)						
9	 9 References Current scientific literature is recommended separately for the individual experiments. The following books can serve as a general reference: Bahaa E. A. Saleh und Malvin Carl Teich, Optik und Photonik, Wiley Eugen Hecht, Optik, Oldenburg Verlag Frank L. Pedrotti, Leno S. Pedrotti, Werner Bausch, Hartmut Schmidt, Optik für Ingenieure, Springer Herman Haken, Hans Christoph Wolf, Atom- und Quantenphysik, Springer Herman Haken, Hans Christoph Wolf, Molekülphysik und Quantenchemie, Springer Peter W. Atkins, Julio de Paula, Michael Bär, Physikalische Chemie, Wiley Wolfgang Demtröder, Laserspektroskopie 1&2, Springer 								

1 1 1	Course nr. 18-fr-1001-ps	Course nr.Course name18-fr-1001-psScientific working and writing						
	Instructor Prof. Dr. habil. To	orsten Frosch	Type Introductory seminar course	SWS 2				

Mo	dule name	g and Writing						
Mo	dule nr	Credit points	Workload	Self-study	Module	luration	Module cv	rle
18-	gr-1001	3 CP	90 h	60 h	1 Term	luration	Every Seme	ester
Lar Ger	iguage man/English		I	Module owner Prof. DrIng. Chr	ristian Grae	eff		
1	Teaching co Content and Elabor Detaile Deeper Practic Learni Presen	ntent l goals ation of a technical t ed study of technical c understanding of th al experience with te ng modern presenta- tation and discussion	opic in cooperatio articles ne technical topic echnical documen tion techniques an n of the technical	n with a research a treated therein tation d their application topic in front of a g	associate as group of pe	s superviso ople	pr	
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	Recommended prerequisites for participation							
4	Form of exa Module exar • Modul Report and/ announced a	mination n: e exam (Study achie or term paper and/o it the beginning of tl	vement, Oral/writh r presentation (in the course.	tten examination, I preparation for the	Default RS) e thesis). T	he type of	examination	will be
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	ırses							
	Course nr. 18-gr-1001-j	Course nameosScientific worl	ting and writing					
	Instructor Prof. DrIng	. Christian Graeff				Type Introduct course	ory seminar	SWS 2

Mo	dule name	1 1						
Sci	entific Workin	g and Writing	1	1				
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-	gt-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester
Lar Ger	nguage rman/English			Module owner Prof. DrIng. Ger	d Griepent	trog		
1	Teaching co Content and Elabor Detaile Deeper Practic Learnin Presen	ntent l goals ation of a technical t ed study of technical c understanding of th al experience with te ng modern presenta- tation and discussion	copic in cooperation articles he technical topic echnical documen tion techniques an n of the technical	on with a research a treated therein tation ad their application topic in front of a g	associate a group of pe	s superviso cople	or	
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	Recommended prerequisites for participation							
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	wement, Oral/writh or presentation (in the course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be
5	Prerequisite Passing the f	e for the award of c inal module examination	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MedTec, B.Sc. W	/I-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	urses							
	Course nr. 18-gt-1001- _I	Scientific work	king and writing					
	Instructor Prof. DrIng	Gerd Griepentrog				Type Introduct course	ory seminar	SWS 2

Mo	dule name							
Scie	entific Working	g and Writing		1	1			
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cy	cle
18-	na-1001	3 CP	90 h	60 h	1 Ierm		Every Seme	ester
Ger	iguage man			Prof. DrIng. Chi	ristoph Hoo	g Antink		
1	 I leaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	3 Recommended prerequisites for participation							
4	Form of exam Module exam • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). Th	he type of	examination	will be
5	Prerequisite Passing the f	for the award of c nal module examin	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. MedTe	the module						
8	Grade bonus	s compliant to §25	(2)					
9	References To be determ	ined individually de	epending on the to	opic.				
Cot	ırses							
	Course nr. 18-ha-1001-1	Course name Scientific worl	king and writing					
	Instructor Prof. DrIng.	Christoph Hoog An	tink			Type Introduct	ory seminar	SWS 2

Mo Scie	dule name entific Workin	g and Writing						
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle
Lar Ger	nguage rman	3 GP	90 11	Module owner Prof. DrIng. Chi	istian Hoc	hberger		ster
1	 Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents. 						manner 1marize	
3	3 Recommended prerequisites for participation							
4	Form of exa Module exar • Modul Report and/ announced a	mination n: e exam (Study achie or term paper and/c it the beginning of t	evement, Oral/wri or presentation (in he course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Ed. etit, B.	the module Sc. und M.Sc. iST, H	3.Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	ourses							
	Course nr. 18-hb-1001-	ps Course name Scientific worl	king and writing					
	Instructor Prof. DrIng	. Christian Hochberg	ger			Type Introduct course	ory seminar	SWS 2

Mo	dule name	1 747 1.1						
Scie	entific Workin	g and Writing					• •	
	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle
18-	10-1001	3 CP	90 h		1 Ierm		Every Seme	ester
Ger	rman/English			Prof. DrIng. Kla	us Hofman	n		
1	 Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	3 Recommended prerequisites for participation Lecture "Elektronische und Integrierte Schaltungen"							
4	Form of exa Module exar • Modul Report and/ announced a	mination n: e exam (Study achie or term paper and/o it the beginning of tl	vement, Oral/wri r presentation (in 1e course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. und M.Sc. iST, B	S.Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 18-ho-1001-	ps Course name Scientific work	king and writing					
	Instructor Prof. DrIng	. Klaus Hofmann				Type Introduct course	ory seminar	SWS 2

Mo	dule name							
Scie	entific Working	g and Writing		I			1	
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
18-	hs-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester
Ger	i guage man/English			Prof. DrIng. Jut	ta Hanson			
1	 I leaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	3 Recommended prerequisites for participation							
4	Form of exam Module exam • Module Report and/c announced a	mination n: e exam (Study achie or term paper and/o t the beginning of th	vement, Oral/wri r presentation (in 1e course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.S	the module Sc. MedTec, B.Sc. W	/I-etit					
8	Grade bonus	s compliant to §25	(2)					
9	References Literature wi	ll be provided based	l on the topic.					
Coi	ırses	-	-					
	Course nr. 18-hs-1001-p	Scientific work	king and writing					
	Instructor Prof. DrIng.	Jutta Hanson				Type Introduct	ory seminar	SWS 2

Mo	dule name	g and Writing						
Mo	dule nr	Credit points	Workload	Self-study	Module	luration	Module cw	าโค
18-	ja-1001	3 CP	90 h	60 h	1 Term	auration	Every Seme	ester
Lar	iguage		I	Module owner	id Voosbla	-hi		
Ger	man/English			Prof. DrIng. Van	ia kooshka	gnazi		
1	Content and Elabor Detaile Deeper Practic Learnin Presen	ntent I goals ation of a technical t ed study of technical understanding of t al experience with te ng modern presenta tation and discussion	opic in cooperatic articles he technical topic echnical documen tion techniques an n of the technical	n with a research a treated therein tation d their application topic in front of a g	associate as group of pe	s supervisc ople	or	
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	Recommended prerequisites for participation							
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in 1e course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the f	e for the award of c inal module examinat	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	urses							
	Course nr. 18-ja-1001-p	Scientific work	king and writing					
	Instructor Prof. DrIng	Vahid Kooshkghazi				Type Introduct course	ory seminar	SWS 2

Mo	dule name							
Scie	entific Working	and Writing						
Мо	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cy	cle
18-	jk-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester
Lar Ger	iguage man/English			Module owner Prof. DrIng. Rol	f Jakoby			
1	 Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 							
2	 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents. 							
3	Recommend Fundamental	ed prerequisites for knowledge in micr	or participation owave engineering	g, e.g. lecture "Hoc	hfrequenz	technik 1".		
4	Form of exam Module exam • Module Report and/o announced at	nination :: exam (Study achie r term paper and/o : the beginning of tl	evement, Oral/wri or presentation (in the course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation					
6	Grading Module exam • Module	: exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of t B.Sc. etit, B.S	he module Sc. MedTec, B.Sc. u	nd M.Sc. iST					
8	Grade bonus	compliant to §25	(2)					
9	References According to the advices and recommendations of the project supervisor							
Coι	ırses							
	Course nr. 18-jk-1001-p	Course name Scientific worl	king and writing					
	Instructor Prof. DrIng.	Rolf Jakoby, DrIng	g. Martin Schüßler	r		Type Introduct course	ory seminar	SWS 2

Mo	dule name	1 747 1.1					
Mo	dule nr.	and Writing	Workload	Self-study	Module dura	tion Module cv	cle
18-	kb-1001	3 CP	90 h	60 h	1 Term	Every Seme	ester
Lar Ger	iguage man/English			Module owner Prof. DrIng. Har	ald Klingbeil		
1	 Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 						
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents						
3	Recommender Good underst	ed prerequisites for anding of electrom	or participation agnetic fields, bro	ad knowledge of va	arious electrical	engineering disci	olines
4	Form of exam Module exam • Module Report and/o announced at	nination : exam (Study achie r term paper and/o the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). The ty	ype of examination	ı will be
5	Prerequisite Passing the fit	for the award of c nal module examina	redit points ation				
6	Grading Module exam • Module	: exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100	%)	
7	Usability of t B.Sc. etit, B.S	he module c. MedTec					
8	Grade bonus	compliant to §25	(2)				
9	References Suitable mate	rial is provided bas	ed on specific top	ic			
Coι	ırses						
	Course nr. 18-kb-1001-p	s Scientific worl	king and writing				
	Instructor Prof. DrIng.	Harald Klingbeil			Typ Intr	oe roductory seminar	SWS 2

Mo	dule name	1						
Sci	entific Workin	g and Writing						
	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-	KC-1001	3 CP	90 h		1 Ierm		Every Seme	ester
Ger	rman/English			Prof. Dr. Myriam	Koch			
1	Teaching co Content and Elabor Detaile Deeper Practic Learnin Presen	ntent l goals ation of a technical t d study of technical understanding of th al experience with to ng modern presenta tation and discussion	opic in cooperation articles he technical topic echnical documen tion techniques an n of the technical	on with a research a treated therein tation Id their application topic in front of a g	associate a group of pe	s superviso cople	or	
2	Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.							
3	Recommended prerequisites for participation							
4	Form of exa Module exar • Module Report and/ announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/writher for presentation (in the course.	tten examination, I preparation for the	Default RS e thesis). T) The type of	examination	will be
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	burses							
	Course nr. 18-kc-1001- _]	Course name Scientific worl	king and writing					
	Instructor Prof. Dr. Myr	iam Koch, M.Sc. Ma	anuel Philipp			Type Introduct course	ory seminar	SWS 2

Mo	dule name	and Writing						
Mo	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cvo	cle
18-	kh-1001	3 CP	90 h	60 h	1 Term	aurution	Every Seme	ester
Lar Ger	nguage rman/English			Module owner Prof. DrIng. Tra	n Quoc Kh	anh	-	
1	Teaching co Content and Elabora Detaile Deeper Practic Learnin Presen	ntent I goals ation of a technical t of study of technical of understanding of the al experience with the ng modern presentation and discussion	opic in cooperatic articles he technical topic echnical documen tion techniques an n of the technical	n with a research a treated therein tation d their application topic in front of a g	associate as group of pe	s supervisc ople	or	
2	Learning ob The students and present it in writing	jectives are able to compred them in a structured and refer to its conte	hend and analyze manner. Using the ents.	scientific texts, pre e example of an ori	sent techn ginal work	ical facts in , they can	n an orderly i correctly sum	manner ımarize
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exan • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the f	e for the award of c inal module examinat	redit points ation					
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	urses	1						
	Course nr. 18-kh-1001-j	Course namepsScientific work	king and writing					
	Instructor Prof. DrIng.	Tran Quoc Khanh				Type Introduct course	ory seminar	SWS 2

Mo	dule name								
Scie	entific Working	and Writing	1	1					
Mo	dule nr.	Credit points	Workload	Self-study	Module dur	ration	Module cyc	cle	
18-	KI-1001	3 CP	90 h	00 II	1 Ierm		Every Seme	ster	
Ger	man/English			Prof. DrIng. Ania Klein					
1	Teaching con Content and • Elabora • Detailed • Deeper • Practica • Learnin • Present	ntent goals tion of a technical t d study of technical understanding of tl d experience with te g modern presentat ation and discussion	opic in cooperatio articles he technical topic echnical documen tion techniques ar n of the technical	on with a research a treated therein tation ad their application topic in front of a g	associate as su group of peopl	1pervisor le			
2	Learning obj The students and present t it in writing a	ectives are able to comprel hem in a structured nd refer to its conto	hend and analyze manner. Using th ents.	scientific texts, pre e example of an ori	sent technical ginal work, th	l facts in a ney can co	an orderly r prrectly sum	manner ımarize	
3	Recommend	ed prerequisites fo	or participation						
4	Form of exam Module exam • Module Report and/o announced at	nination : exam (Study achie r term paper and/o the beginning of th	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). The	type of e	xamination	will be	
5	Prerequisite Passing the fi	for the award of c	redit points ation						
6	Grading Module exam • Module	: exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 10	00 %)			
7	Usability of t B.Sc. etit, B.S	he module c. MedTec, B.Ed. et	tit, B.Sc. und M.S	c. iST, B.Sc. WI-eti	t				
8	Grade bonus	compliant to §25	(2)						
9	References Literature wi	l be announced du	ring the course.						
Cou	ırses								
	Course nr.	Course name	ving and writing						
	Instructor Prof. DrIng.	Anja Klein			Ty In	ype itroductor	ry seminar	SWS 2	

Mo	dule name	and Writing						
Mo	dule nr	Credit points	Workload	Self-study	Module d	luration	Module cvo	rle
18-	kn-1001	3 CP	90 h	60 h	1 Term	luiution	Every Seme	ester
Lar Ger	nguage rman			Module owner Prof. Dr. Mario K	upnik			
1	Teaching co Content and Elabora Detaile Deeper Practice Learnin Present	ntent goals ation of a technical t d study of technical understanding of t al experience with to ng modern presenta cation and discussion	copic in cooperatic articles he technical topic echnical documen tion techniques an n of the technical	on with a research a treated therein tation Id their application topic in front of a g	associate as group of pe	supervisc	DT	
2	Learning ob The students and present t it in writing	jectives are able to compred hem in a structured and refer to its conte	hend and analyze manner. Using the ents.	scientific texts, pre e example of an ori	sent techni ginal work	cal facts in , they can	n an orderly i correctly sum	manner 1marize
3	Recommend	ed prerequisites fo	or participation					
4	Form of exam Module exam • Module Report and/c announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/writh or presentation (in the course.	tten examination, I preparation for the	Default RS) e thesis). T	he type of	examination	will be
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.S	the module Sc. MedTec, B.Sc. W	/I-etit					
8	Grade bonus	s compliant to §25	(2)					
9	References							
Co	urses							
	Course nr. 18-kn-1001-j	Course nameosScientific worl	king and writing					
	Instructor Prof. Dr. Mar	io Kupnik				Type Introduct course	ory seminar	SWS 2

Mo	dule name	and Writing						
Mo	dulo pr	Credit points	Workload	Solf-study	Module	luration	Module ov	مام
18-	kp-1001	3 CP	90 h	60 h	1 Term	luiation	Every Seme	ester
Lar Eng	iguage glish		I	Module owner Prof. Dr. techn. H	leinz Köppl	l		
1	Teaching co Content and Elabora Detaile Deepen Practic Learnin Presen	ntent l goals ation of a technical t d study of technical understanding of t al experience with to ng modern presenta tation and discussion	copic in cooperatic articles he technical topic echnical documen tion techniques an n of the technical	on with a research a treated therein tation Id their application topic in front of a g	associate as group of pe	s supervisc ople	or	
2	Learning ob The students and present it in writing	jectives are able to compred hem in a structured and refer to its conte	hend and analyze manner. Using the ents.	scientific texts, pre e example of an ori	sent techni ginal work	ical facts in , they can	n an orderly i correctly sum	manner 1marize
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	wement, Oral/writher of the oral of the oran of the oran of the oran of the oran of the or	tten examination, I preparation for the	Default RS) e thesis). T	he type of	examination	will be
5	Prerequisite Passing the f	for the award of c inal module examin	redit points ation					
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MedTec, B.Sc. W	/I-etit					
8	Grade bonu	s compliant to §25	(2)					
9	9 References							
Cot	urses							
	Course nr. 18-kp-1001-	Course name Scientific worl	king and writing					
	Instructor Prof. Dr. tech	ın. Heinz Köppl				Type Introduct course	ory seminar	SWS 2

Mo	dule name									
Scie	entific Working	g and Writing		1						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cy	cle		
18-	me-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester		
Lar Fnc	iguage rlish			Prof Dr rer nat Markus Meinert						
1	Teaching co Content and Elabora Detaile Deeper Practica Learnir Present	ntent goals attion of a technical t d study of technical understanding of t al experience with t ag modern presenta ation and discussion	topic in cooperation articles he technical topic echnical documen tion techniques ar n of the technical	on with a research a treated therein tation ad their application topic in front of a g	associate as group of pe	s superviso ople)r			
2	Learning ob The students and present t it in writing a	jectives are able to compre hem in a structured and refer to its cont	hend and analyze manner. Using th ents	scientific texts, pre e example of an ori	sent techni ginal work	ical facts in , they can	n an orderly i correctly sum	manner 1marize		
3	Recommended prerequisites for participation									
4	Form of exam Module exam • Module Report and/c announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	evement, Oral/wri or presentation (in he course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be		
5	Prerequisite Passing the fi	for the award of c nal module examin	r edit points ation							
6	Grading Module exan • Module	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Weighting:	100 %)				
7	Usability of B.Sc. etit	the module								
8	Grade bonus	s compliant to §25	(2)							
9	References Lecture notes	s: Introduction to S	pintronics (Prof. N	Iarkus Meinert)						
Coi	ırses	-	•							
	Course nr.	Course name	1							
	18-me-1001-	ps Scientific worl	king and writing							
	Instructor Prof. Dr. rer.	nat. Markus Meiner	Instructor Type SWS Prof. Dr. rer. nat. Markus Meinert Introductory seminar 2							

Ma	dula nomo							
Scie	entific Working	and Writing						
Мо	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-	mu-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester
Lar Ger	ıguage man∕English			Module owner Prof. DrIng. Mic	hael Mum	a		
1	Teaching con Content and Elabora Detailed Deeper Practica Learnin Present	ntent goals tion of a technical to d study of technical understanding of to l experience with to g modern presenta ation and discussio	topic in cooperatio articles he technical topic echnical documen tion techniques ar n of the technical	on with a research a treated therein tation ad their application topic in front of a g	associate a group of pe	s superviso eople	or	
2	Learning obj The students and present t it in writing a	ectives are able to compre nem in a structured nd refer to its cont	hend and analyze manner. Using th ents.	scientific texts, pre e example of an ori	sent techn ginal work	ical facts i , they can	n an orderly i correctly sum	manner 1marize
3	Recommend	ed prerequisites fo	or participation					
4	Form of exam Module exam • Module Report and/o announced at	nination : exam (Study achie r term paper and/c the beginning of t	evement, Oral/wri or presentation (in he course.	tten examination, I preparation for the	Default RS e thesis). T) The type of	examination	will be
5	Prerequisite Passing the fi	for the award of c nal module examin	r edit points ation					
6	Grading Module exam • Module	: exam (Study achie	evement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of 1 B.Sc. etit	he module						
8	Grade bonus	compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 18-mu-1001-	Course nameosScientific world	king and writing					
	Instructor Prof. DrIng.	Michael Muma				Type Introduct course	ory seminar	SWS 2

Mo	dule name	1 747 1.1						
SCI	entific Workin	g and Writing						
	dule nr.	Credit points	Workload	Self-study	Module of 1 Torm	duration	Module cyc	cle
10-	pe-1001	3 CP	90 11	No dulo overon	1 Ieiiii		Every Sellie	ster
Ger	man/English			Prof. DrIng. Ma	rius Pesave	ento		
1	Teaching co Content and Elabor: Detaile Deeper Practic Learnin Presen	ntent l goals ation of a technical t ed study of technical e understanding of tl al experience with te ng modern presentat tation and discussion	opic in cooperation articles he technical topic echnical documen tion techniques an n of the technical	on with a research a treated therein tation Id their application topic in front of a g	associate a group of pe	s superviso cople)r	
2	Learning ob The students and present it in writing	jectives are able to comprel them in a structured and refer to its conto	hend and analyze manner. Using the ents	scientific texts, pre e example of an ori	sent techn ginal work	ical facts in , they can	n an orderly 1 correctly sum	manner 1marize
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/writh or presentation (in the course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be
5	Prerequisite Passing the f	e for the award of c inal module examinat	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Ed. etit, B.Sc. und M	I.Sc. iST, B.Sc. W	I-etit				
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 18-pe-1001-j	ps Course name Scientific work	king and writing					
	Instructor Prof. DrIng.	Marius Pesavento				Type Introduct course	ory seminar	SWS 2

Мо	dule name							
Scie	entific Working	g and Writing	1	1				
Mo	dule nr.	Credit points	Workload	Self-study	Module of	duration	Module cy	cle
18-	pr-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester
Ger	iguage man/English			Prof. Dr. rer. nat.	Sascha Pr	e11		
1	Teaching co Content and Elabora Detaile Deeper Practica Learnin Present	ntent goals ation of a technical t d study of technical understanding of t al experience with to ag modern presenta- cation and discussion	opic in cooperatic articles he technical topic echnical documen tion techniques ar n of the technical	on with a research a treated therein tation ad their application topic in front of a g	associate a group of pe	s supervisc cople	or	
2	Learning ob The students and present t it in writing a	jectives are able to comprel hem in a structured and refer to its conto	hend and analyze manner. Using th ents.	scientific texts, pre e example of an ori	sent techn ginal work	ical facts in t, they can	n an orderly i correctly sum	manner 1marize
3	Recommended prerequisites for participation							
4	Form of exam Module exam • Module Report and/c announced a	mination a: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in 1e course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.S	the module Sc. WI-etit						
8	Grade bonus	s compliant to §25	(2)					
9	9 References Suggestions will be provided upon definition of the topic.							
Coι	ırses							
	Course nr.	Course name						
	18-pr-1001-p	s Scientific work	and writing			Trans -		01470
	Prof. Dr. rer.	nat. Sascha Preu				I ype Introduct course	ory seminar	2

Мо	dule name								
Sci	entific Working	g and Writing	1	1					
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle	
18-	sc-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester	
Lar Ger	iguage man			Module owner Prof. Dr. rer. nat. Sebastian Schöps					
1	Teaching co Content and Elabora Detaile Deeper Practica Learnin Present	ntent goals ation of a technical t d study of technical understanding of t al experience with t ng modern presenta ation and discussion	copic in cooperation articles he technical topic echnical documen tion techniques an n of the technical	on with a research a treated therein tation Id their application topic in front of a g	associate a group of pe	s superviso cople	or		
2	Learning ob The students and present t it in writing	jectives are able to compred hem in a structured and refer to its conte	hend and analyze manner. Using the ents.	scientific texts, pre e example of an ori	esent techn ginal work	ical facts in , they can	n an orderly 1 correctly sum	manner 1marize	
3	Recommend	ed prerequisites fo	or participation						
4	Form of exam Module exam • Module Report and/c announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	evement, Oral/writh or presentation (in he course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be	
5	Prerequisite Passing the f	for the award of c	redit points ation						
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of B.Sc. etit	the module							
8	Grade bonus	s compliant to §25	(2)						
9	9 References								
Cot	urses								
	Course nr. 18-sc-1001-p	Scientific worl	king and writing						
	Instructor Prof. Dr. rer.	nat. Sebastian Schö	ps			Type Introduct course	ory seminar	SWS 2	

Мо	dule name							
Scie	entific Workin	g and Writing	1	I				
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cy	cle
18-	sm-1001	3 CP	90 h	60 h	1 Term		Every Seme	ester
Lan	iguage			Module owner	Biörn Sch	ouormann		
1	Tooching co	ntont		1101. DI. 101. Hat.	bjoin Sen	cucimann		
1	Content and	l goals ation of a technical t	onic in cooperatio	n with a research :	associate a	s superviso	nr	
	• Detaile	d study of technical	articles	in with a rescarch t	abboerate a	b buper vise	,1 ,1	
	Deeper	understanding of t	he technical topic	treated therein				
	 Practic Learning 	al experience with t	echnical documen	tation				
	 Presen 	tation and discussion	n of the technical	topic in front of a g	roup of pe	eople		
				1 0		1		
2	Learning ob The students	jectives are able to compre-	hend and analyze	scientific texts. pre	sent techn	ical facts i	n an orderly i	manner
	and present	them in a structured	manner. Using the	e example of an ori	ginal work	, they can	correctly sum	ımarize
	it in writing	and refer to its cont	ents.					
3	Recommend	led prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or term paper and/or presentation (in preparation for the thesis). The type of examination will be 							
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading							
	Module exar	1:						
	• Module	e exam (Study achie	evement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B Sc. etit. B	the module						
8	Grade hom	s compliant to 825	(2)					
	Grude Donu		(2)					
9	 References Depending on specific topic (selected articles of journals, magazines, and conferences). 							
Coi	ırses							
	Course nr.	Course name						
	18-sm-1001-	ps Scientific worl	king and writing					
	Instructor					Туре		SWS
	Prof. Dr. rer. Ralf Steinme	nat. Björn Scheueri tz	nann, M.Sc. Praty	ush Agnihotri, Pro	f. DrIng.	Introduct course	ory seminar	2

Mo	dule name	g and Writing						
Mo	dule nr	Credit points	Workload	Self-study	Module o	luration	Module cvo	cle
18-	st-1001	3 CP	90 h	60 h	1 Term	iurution	Every Seme	ester
Lar	iguage man/English		1	Module owner Prof Dr rer nat	Florian St	einke	-	
1	Teaching co Content and Elabora Detaile Deeper Practic Learnin Present	ntent l goals ation of a technical t of study of technical of understanding of the al experience with te ng modern presentation and discussion	opic in cooperation articles the technical topic echnical documen tion techniques an n of the technical	n with a research a treated therein tation d their application topic in front of a g	associate as group of pe	s superviso ople	or	
2	Learning ob The students and present it in writing	jectives are able to comprel them in a structured and refer to its conte	hend and analyze manner. Using the ents.	scientific texts, pre e example of an ori	sent techn ginal work	ical facts in , they can	n an orderly 1 correctly sum	manner nmarize
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exan • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of th	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be
5	Prerequisite Passing the f	e for the award of c inal module examina	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)					
9	P References							
Co	ırses							
	Course nr. 18-st-1001-p	s Scientific work	king and writing					
	Instructor Prof. Dr. rer.	nat. Florian Steinke				Type Introduct course	ory seminar	SWS 2

Mo	Module name										
Scie	entific Working	and Writing	I	I			1				
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cy	cle			
18-	su-1001	3 CP	90 h	60 h	1 Term		Summer ter	rm			
Lar Ger	iguage			Prof Dr rer nat Andreas Schürr							
1	Teaching cor	itent		Tion Di Ten nut	7 indieds b	ciruir					
1	 Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 2 Learning objectives 										
2	Learning obj The students present techn original work	ectives are able to assess ti ical facts in an orde , they can correctly	he reliability of in rly manner and pr summarize it in v	formation sources, resent them in a str vriting and refer to	compreher ouctured ma its conten	nd and an anner. Usir ts.	alyze scientif 1g the examp	ic texts, le of an			
3	Recommende	ed prerequisites fo	or participation								
4	Form of exam Module exam • Module Report and/o announced at	nination : exam (Study achie r term paper and/o the beginning of tl	vement, Oral/wri r presentation (in 1e course.	tten examination, I preparation for the	Default RS) e thesis). T) he type of	examination	will be			
5	Prerequisite Passing the fit	for the award of c nal module examina	redit points ation								
6	Grading Module exam • Module	: exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)					
7	Usability of t B.Sc. etit, B.E	he module d. etit, B.Sc. und M	1.Sc. iST, B.Sc. W	l-etit							
8	Grade bonus	compliant to §25	(2)								
9	9 References https://www.es.tu-darmstadt.de/lehre/aktuelle-veranstaltungen/sst-s										
Coi	ırses										
	Course nr. 18-su-1001-p	Scientific work	king and writing								
	Instructor Type SWS Prof. Dr. rer. nat. Andreas Schürr Introductory seminar 2										

Mo	dule name	g and Writing							
Mo	dule nr	Credit points	Workload	Self-study	Module	duration	Module cv	าโค	
18-	zh-1001	3 CP	90 h	60 h	1 Term	auration	Every Seme	ester	
Lar Ger	n guage rman/English			Module owner Prof. DrIng. Li Z	Zhang				
1	 I leaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 								
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.								
3	Recommend	led prerequisites fo	or participation						
4	Form of exa Module exar • Module Report and/o announced a	mination n: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in 1e course.	tten examination, I preparation for the	Default RS) e thesis). T) The type of	examination	will be	
5	Prerequisite Passing the f	e for the award of c inal module examination	redit points ation						
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit							
8	Grade bonu	s compliant to §25	(2)						
9	References								
Coi	urses								
	Course nr. 18-zh-1001-	Course name Scientific work	king and writing						
	Instructor Prof. DrIng	Li Zhang				Type Introduct course	ory seminar	SWS 2	

Mo	dule name	1 747 1.1							
Scie	entific Working	g and Writing		- 10 1				-	
Mo	dule nr.	Credit points	Workload	Self-study	Module du	iration	Hodule cyc	cle	
Io-	20-1001	5 CP	90 11	Modulo ownor	1 Ieiiii		Every Sellie	ster	
Eng	lish			Prof. DrIng. Abd	lelhak Zoubi	ir			
1	 I leaching content Content and goals Elaboration of a technical topic in cooperation with a research associate as supervisor Detailed study of technical articles Deeper understanding of the technical topic treated therein Practical experience with technical documentation Learning modern presentation techniques and their application Presentation and discussion of the technical topic in front of a group of people 								
2	2 Learning objectives The students are able to comprehend and analyze scientific texts, present technical facts in an orderly manner and present them in a structured manner. Using the example of an original work, they can correctly summarize it in writing and refer to its contents.								
3	Recommend	ed prerequisites fo	or participation						
4	Form of exam Module exam • Module Report and/c announced a	nination h: e exam (Study achie or term paper and/o t the beginning of tl	vement, Oral/wri r presentation (in ne course.	tten examination, I preparation for the	Default RS) e thesis). Th	e type of	examination	will be	
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation						
6	Grading Module exam • Module	n: exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 1	.00 %)			
7	Usability of B.Sc. etit, B.S	t he module Sc. und M.Sc. iST, B	S.Sc. WI-etit						
8	Grade bonus	compliant to §25	(2)						
9	References Literature wi	ll be announced ind	ividually dependi	ng on the chosen to	opic.				
Coi	ırses								
	Course nr.	Course name							
	18-zo-1001-p	s Scientific worl	king and writing						
	Instructor Prof. DrIng.	Abdelhak Zoubir				Type Introducto course	ory seminar	SWS 2	

1.5 Project Seminars

Mo EET	dule name 7 Design Proje	ect						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lar Ger	nguage man	5.01	130 11	Module owner Prof. DrIng. Yve	s Burkhardt	winter term		
1	Teaching co This module	ontent e consists of two part	s.					
	Part A: Th energy sour Work steps:	e students build a c ces or an external spo	cycle computer f eed sensor.	or wheel-hub dyn	amos that does not	have any external		
	 1. Operating behaviour of a wheel-hub dynamo (single-phase alternating current machine) 2. Power electronic circuits for voltage stabilization 3. Circuit technology for speed measurement 4. Microcontroller programming with integration of an LCD display Part B: The students get the possibility to design and construct their own fixture, which contains a ball track and a ball elevator mechanism. Therefore dimensional plans have to be understood correctly. Afterwards all components (i.e. circuit board, rails and holders) have to be designed and manufactured within the electronic lab and the workshop, where students work independently with turning, drilling and milling machines. This part allows students to gain practical experience and knowledge in construction, assembling and PCB layout design. 							
2	Learning of After the co suitable circ perform ma students lea	bjectives mpletion of this moc cuit, micro controller chining processes ac rn about managing a	lule, students kno c and setting up a cordingly. Addition project, present p	w the tasks in the circuit. They kno onally, they learn h project results and	electronics developr w how to interpret o ow to create a PCB o practiced teamwork.	nent like choice of a drawing and how to lesign. Furthermore,		
3	Recommen Electrical Er	ded prerequisites for ngineering and Inform	or participation nation Technology	/ I & II, General Co	mputer Science I			
4	Form of exa Module exa • Modul Report and/	amination m: le exam (Study achie 'or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.		
5	Prerequisit Passing the	e for the award of c final module examination	redit points ation					
6	Grading Module exa • Modul	m: le exam (Study achie	vement, Oral/writ	tten examination, V	Weighting: 100 %)			
7	Usability of B.Sc. etit	the module						
8	Grade bonu	is compliant to §25	(2)					
9	References							

	 Detailed textbook F. Barrett: Arduino I Getting Started, Morgan & Claypool, 2020 U. Tietze, C. Schenk, E. Gamm: Halbleiter-Schaltungstechnik, Springer, 2019 J. Dillinger et al.: Fachkunde Metall, Europa-Lehrmittel, 2007 						
Co	ırses						
	Course nr. 18-bt-1070-pj	Course name EET Design Project					
	InstructorTypeSWSProf. DrIng. Yves Burkhardt3						

Mo	Module name Project Seminar Drive Systems"								
Mo 18-	dule nr. bt-1080	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module d	uration	Module cyc Every Seme	cle ester	
Lar Ger	nguage rman/English		1	Module owner Prof. DrIng. Yve	s Burkhardt	t			
1	Teaching co From the tas students in g experimenta	ntent ks published by the o groups of two to four l and includes scient	department for the persons under su tific questions on e	eses, sub-tasks are of pervision. The focu- electrical energy co	lerived, whi is of the wor nversion an	ich are to rk can be d electrica	be worked or both theoreti al drive techr	n by the ical and nology.	
2	Learning of After complet or more area have learned	ojectives ting the module, stud as of electrical energ to present project re	dents will be able t y converters, elect esults in written a	o work independer rical drive technol nd oral form in con	ntly in a tear ogy and cor npliance wit	n on scien ntrol of el th the rule	tific problems ectrical drive es for scientifi	s in one s. They c work.	
3	 Recommended prerequisites for participation Fundamentals on Electrical Engineering, three-phase systems, mechanics; Lecture "Electrical Machines and Drives" 								
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation and/or Colloquium. The type of examination will be announced in the beginning of the lecture 								
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/writ	ten examination, V	Weighting: 1	100 %)			
7	Usability of B.Sc. etit	the module							
8	Grade bonu	s compliant to §25	(2)						
9	References Depending o 1"	n the project task; ma	anuscripts from the	e lectures "Electrica	l Machines a	and Drives	", "Regelungs	technik	
Cot	urses								
	Course nr. 18-bt-1080-j	Course nameojProject Semin	ar "Drive Systems'	د					
	Instructor Prof. DrIng	. Yves Burkhardt				Type Project se	eminar	SWS 3	

Mo Pro	dule name ject Seminar	Analysis, Measureme	ent and Simulatior	n of electromagneti	c set-ups		
Mo 18-	dule nr. dg-1090	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration 1 Term	Module cycle Winter term	
Lar Ger	iguage rman/English	1		Module owner Prof. DrIng. Her	bert De Gersem	1	
1	Teaching	ntont		0			
 1 Teaching content Analysis, experiment and simulation of exemplary electrical devices, e.g.: Single-phase transformer Analytical calculation of various parameters of the transformer Experimental setup with iron yoke and coils, various measurements and experi-ments (e.g. shor circuit test, measurements with and without airgap, with and without iron core, etc.) Modeling & simulation of the experimental setup using CST EM Studio Cavity resonator Analytical calculation of resonance frequencies Calibration of a network analyzer Measurement of diverse cavity resonators by means of a network analyzer Modeling & simulation of cavity resonators using CST EM Studio Electrical motor Analytical calculation of various parameters of the motor Construction of own electrical motor with common household material Optimization of the rotational speed Modeling & simulation of the built motor using CST EM Studio Vibrations and beats Analytical calculation of coupled oscillating circuits (beat phenomenon) Pendulum experiments and measurements of the frequencies using a cell phone app Comparison between mechanical and electrical oscillating circuits Modeling & simulation of coupled oscillating circuits using a cell phone app 							
	• Catho – A – M – F – N	de-ray tube nalytical calculation Aeasurement of deflect lotting, reading and Modeling & simulation	of various parame ctions in the elect interpreting Lissaj n of Helmholtz co	eters of the cathode rical field jous figures ils and cathode-ray	e-ray tube	Studio	
2	Learning of The student several exer carry out m results and simulation a	bjectives ts are able to explain nplary electrical devic easurements for the e reporting them in a c und experiment in ele	the physical wor ces. They are able exemplary setups concise way. They ectrical engineerin	king principle, tec to evaluate analyti They are capable are acquinted with g.	hnical implementati cal models, set up sin of critically assessing the strengths and v	ion and relevance of mulation models and g and comparing the veaknesses of theory,	
3	 Recommended prerequisites for participation Basic knowledge on electric circuits and electromagnetic fields which is part of, e.g., Electrical Engineering and Information Technology I and Electrical Engineering and Information Technology II 						
4	Form of exa Module exa • Modul Report and	amination m: le exam (Study achie for Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.	
5	Prerequisit	e for the award of c	redit points				

	Passing the final	module examination					
6	 Grading Module exam: Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 						
7	Usability of the module B.Sc. etit, B.Sc. CE						
8	Grade bonus compliant to §25 (2)						
9	References Experiment instr	uctions					
Coi	ırses						
	Course nr.Course name18-dg-1090-pjProject Seminar Analysis, Measurement and Simulation of electromagnetic set-ups						
	Instructor Prof. DrIng. Hei	bert De Gersem	Type Project seminar	SWS 4			

Mo Pro	dule name ject Seminar I	Implementation of P	ower Electronic Sy	/stems				
Mo	dule nr. ∞t-1030	Credit points	Workload	Self-study	Module du	ration	Module cyc	cle ester
Lar Ger	n guage man/English	0.01	100 11	Module owner Prof. DrIng. Ger	d Griepentro	og	livery benne	
1	Teaching co In an introdu During the s • Simula • Impler • Sugges The students and at the e	ontent actory meeting topics eminary problems ca ation of basic power of nenting and commis sted topics from the s are working autono nd of the module, a p	s according to pow an be treated conc electronic systems sioning of power e students are welco pmous on the chos presentation abou	ver electronics and cerning the followir electronic systems ome en problem. The re t the problem must	control of dri ng topics: esults are doo be held.	ives are g	iven to the s	tudents. 1 report
2	 2 Learning objectives On completion of the module students will have learned the following: Familiarization with a given problem Development of a project plan and its follow-up Usage of development tools Practical experience in power electronics and control of drives Logical presentation of the results in a report Presentation skills 							
3	Recommene Lecture "Lei	ded prerequisites for stungselektronik 1" of	or participation or "Einführung En	ergietechnik" and	ggf. "Regelur	ngstechni	ik I" or simila	ar
4	Form of exa Module exa • Modul Report and/ the lecture.	mination n: e exam (Study achie or Presentation and/	vement, Oral/writ or Colloquium. Th	tten examination, I le type of examinat	Default RS) ion will be ar	nnouncec	l in the begir	ning of
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exa • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Weighting: 10	00 %)		
7	Usability of B.Sc. etit	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References Definition of	project task						
Cot	ırses	1						
	Course nr. 18-gt-1030-j	Course nameojProject Semination	ar Implementatior	n of Power Electron	ic Systems			
	Instructor Prof. DrIng	. Gerd Griepentrog			T P	T ype Project se	minar	SWS 3

Mo Pro	Module name Project Seminar Computer Systems								
Mo 18-	dule nr. hb-1040	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration 1 Term	Module cy Every Seme	cle ester		
Lar Ger	iguage man			Module owner Prof. DrIng. Chr	ristian Hochberger				
1	Teaching co Students ela documentati solutions to a	ntent borate on a researc on and a presentat a given problem.	h-oriented subjec ion of the acquire	t in the area of co ed advanced know	mputer-systems. The ledge. They provide	ey present a e a set of alte	written ernative		
2	2 Learning objectives Students are able to systematically develop design alternatives to a given problem. They learn to acquire the necessary fundamental knowledge in terms of references and terminology.								
3	3Recommended prerequisites for participationBasic knowledge of digital design								
4	Form of exa Module exan • Module Report and/o	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	ten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture	e.		
5	Prerequisite Passing the f	for the award of c nal module examin	redit points ation						
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/writ	ten examination, V	Weighting: 100 %)				
7	Usability of B.Sc. etit, B.	the module Sc. und M.Sc. iST, B	.Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)						
9	References								
Co	urses								
	Course nr. 18-hb-1040-	oj Course name Project Semin	ar Computer Syste	ems					
	Instructor Prof. DrIng.	Christian Hochberg	ger		Type Project se	eminar	SWS 4		

Mo Pro	Iodule name Project Seminar Integrated Electronic Systems								
Mo 18-	dule nr. ho-1060	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration 1 Term	Module cy Every Seme	cle ester		
Lar Ger	iguage man			Module owner Prof. DrIng. Kla	us Hofmann				
1	Teaching co Research-ori Final Report	ntent ented project in the and Presentation of	e domain of Integr Results in a Team	rated Electronic Sy	stems or Microelect	ronic System	Design,		
2	2 Learning objectives After completion of this module, a student is able to fulfill/implement a given task or project in the domain of Integrated Electronic System design (optionally in a group of students), write a final report and present the results to an audience.								
3	3 Recommended prerequisites for participation Lecture Electronic and Integrated Circuits								
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 30 Min., Default RS) 								
5	Prerequisite Passing the f	for the award of c nal module examin	redit points ation						
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)				
7	Usability of B.Sc. etit, B.	the module Sc. und M.Sc. iST							
8	Grade bonu	s compliant to §25	(2)						
9	References Material on t	he subject will be h	anded out						
Cot	urses								
	Course nr. 18-ho-1060-	Course name oj Project Semin	ar Integrated Elec	tronic Systems					
	Instructor Prof. DrIng.	Klaus Hofmann			Type Project s	eminar	SWS 4		

Mo Pro	dule name ject Seminar I	Electrical Power Syst	ems				
Mo 18-	dule nr. hs-1090	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module duration 1 Term	Module cy Every Seme	cle ester
Lar Ger	nguage rman			Module owner Prof. DrIng. Jut	ta Hanson	·	
1	Teaching co Students ela documentat solutions to More inform	ontent borate on a research- ion and/or a presen a given problem. ation can be found l	oriented subject in tation of the acqu nere.	n the area of electri ired advanced kno	cal power systems. Th wledge. They provide	ney present a e a set of alte	written ernative
2	Learning of After success minology) or work out alt	jectives ful completion of the a research-oriented ernative solutions to	e module, students topic and present a given problem.	have learned how it in a summarised	to acquire basic know form. They have lear	ledge (literat ned to systen	ure, ter- natically
3	Recomment	led prerequisites fo	or participation				
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Beport and/or Presentation. The type of examination will be appounded in the beginning of the lecture 						
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation				
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit	the module					
8	Grade bonu	s compliant to §25	(2)				
9	References						
Coi	urses						
	Course nr. 18-hs-1090-	pj Course name Project Semin	ar Electrical Powe	r Systems			
	Instructor Prof. DrIng	. Jutta Hanson			Type Project se	eminar	SWS 3

Мо	Module name								
Pro	ject Seminar (Communication and	Sensor Systems						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	uration	Module cy	cle	
18-	jk-1041	8 CP	240 h	180 h	1 Term		Every Seme	ester	
Lar Ger	Iguage man/English			Prof Dr-Ing Rol	f Iakoby				
1	Teaching co Investigating communicati will be define organizing a given task, s results and c	ntent and solving specific ons engineering, mid ed out of the recent nd structuring of a s ummarizing achieve onclusions and defe	problems concerni crowave technolog research topics of seminar task, searc ed results and con nding them in an	ing communication y, signal processing the involved labs) ching and analyzin clusions by means oral discussion incl	and sensor s, sensor net , working o g of scientif of a writter uding audio	systems (1 tworks etc on a a give fic referen n report, j ence.	Problems con are possible n task by one ce publication presenting ac	cerning e, topics e's own, ns for a chieved	
2	 2 Learning objectives Upon successful completion of the module, students will be able to: the ability to apply methods of communication and sensor systems to practical problems deep and special knowledge in a particular field of communication and sensor systems (communications engineering), RF technology, signal processing, sensor networks the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report the ability to present and discuss achieved results in the form of a presentation in front of an audience 								
3	 Recommended prerequisites for participation Previous knowledge in chosen discipline, e.g. communication technology, signal processing, microwave technology, sensor networks 								
4	Form of exa Module exam • Module Report and/o	mination 1: 2 exam (Study achie or Presentation. The	vement, Oral/writ	ten examination, I ion will be announ	Default RS) ced in the b	beginning	of the lecture	2.	
5	Prerequisite Passing the f	for the award of c	redit points ation						
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/writ	ten examination, V	Veighting: 1	100 %)			
7	Usability of B.Sc. etit, B.S	the module Sc. und M.Sc. iST							
8	Grade bonu	s compliant to §25	(2)						
9	References Will be anno	unced in the lecture							
Cot	arses								
	Course nr. 18-jk-1041-p	j Project Semin	ar Communication	and Sensor System	ns				
	Instructor Prof. DrIng.	Rolf Jakoby, DrIng	g. Martin Schüßler	· · · · · · · · · · · · · · · · · · ·		Type Project se	minar	SWS 4	
Mo Pro	dule name ject Seminar I	Particle Accelerator 7	Гechnology						
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Mo 18-	dule nr. kb-1020	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module of 1 Term	duration	Module cy Every Seme	cle ester	
Lar Ger	iguage man/English			Module owner Prof. DrIng. Hai	ald Klingb	eil	-		
1	Teaching co Work on a m measuremer	ontent ore complex project i nt aspects, analytical	n the field of partic aspects, and simu	cle accelerator tech lation aspects will	nology. Dej be include	pending on d.	the specific p	vroblem,	
2	Learning of Students wil approaches of errors. They organize tea	Djectives I be able to solve con or simulation method 7 know how to prese mwork.	nplex engineering ls. They are able to ent the results on	problems with diff o estimate measure a scientific level ir	erent meas ment error talks and	surement t rs and mod l a paper.	echniques, an leling and sim Students are	alytical ulation able to	
3	Recomment Good unders	ded prerequisites for standing of electrom	or participation agnetic fields, bro	ad knowledge of d	ifferent ele	ectrical eng	ineering disc	iplines.	
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation. The type of examination will be announced in the beginning of the lecture. 								
5	Prerequisite Passing the f	e for the award of c	redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of B.Sc. etit, M	the module .Sc. MedTec							
8	Grade bonu	s compliant to §25	(2)						
9	References Suitable mat	terial is provided bas	ed on specific pro	blem.					
Cot	ırses								
	Course nr. 18-kb-1020-	pj Course name Project Semina	ar Particle Acceler	ator Technology					
	Instructor Prof. DrIng Christoph W	g. Harald Klingbeil, egmann	, M.Sc. Sebastian	ı Orth, M.Sc. Yi J	in, M.Sc.	Type Project se	eminar	SWS 4	

Mo Pro	dule name ject Seminar I	High-Voltage Techno	logy					
Мо	dule nr.	Credit points	Workload	Self-study	Module dur	ation	Module cyc	cle
18-	kc-1020	- 6 CP	180 h	135 h	1 Term		Every Seme	ster
Lar Ger	iguage man			Module owner Prof. Dr. Myriam	Koch			
1	I Teaching content In this seminar, students plan, construct, commission and document devices from the field of high-voltage test and measurement technology in the form of a development project. The built devices will be used, where possible, to carry out initial scientific investigations. The aim is to work in a similar way to a development department in industry, using processes that are frequently applied today (creation of specifications and requirements, division of the project into sub-projects, naming of responsible persons, definition of "milestones", review meetings, documentation and final presentation). The results are summarized in a written report and a final presentation. The students typically work in small groups.							
2	 Learning objectives After successful completion of the module, the students can apply the methodology of design and development from the very first customer requirements specification up to design and type tests and documentation of equipment in high-voltage technology. They have successfully experienced team work and self-independently developed, built and tested a real device from the beginning. 							
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exar • Module Report and/o	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ	tten examination, I ion will be announ	Default RS) ced in the beg	ginning o	of the lecture	2.
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 10	0 %)		
7	Usability of B.Sc. etit	the module						
8	Grade bonu	s compliant to §25	(2)			_		_
9	References Depending o	n actual project						
Co	Courses							
	Course nr. 18-kc-1020-j	oj Project Semin	ar High-Voltage Te	echnology				
	Instructor Prof. Dr. Myr	riam Koch			Ty Pr	ype roject sei	minar	SWS 3

Mo Pro	dule name ject Seminar (Communication and	Sensor Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	kl-1041	8 CP	240 h	180 h	1 Term	Every Seme	ester
Lan Ger	iguage man/English			Module owner Prof. DrIng. Anj	a Klein		
1	Teaching co Investigating defined out c and structur summarizing conclusions a	ntent g and solving specif f the recent research ing of a seminar tasl g achieved results an and defending them	ic problems conce n topics of theresea k, searching and a nd conclusions by in an oral discuss	erning communica urch group. Working nalyzing of scientif means of a written ion including audie	tion and sensor syst g on a given task by c fic reference publicat n report, presenting ence.	ems. Topics one's own, org ions for a giv achieved resu	will be anizing en task, alts and
2	 2 Learning objectives Upon successful completion of the module, students will be able to: the ability to apply methods of communication and sensor systems to practical problems deep and special knowledge in a particular field of communication and sensor systems the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report the ability to present and discuss achieved results in the form of a presentation in front of an audience 						
3	Recommend Previous kno	led prerequisites fo wledge in chosen di	or participation scipline of commu	inication and sense	or systems		
4	Form of exa Module exar • Module Report and/o	mination n: e exam (Study achie or Presentation. The	vement, Oral/write type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture	e.
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Ed. etit, B.Sc. und M	I.Sc. iST, B.Sc. W	-etit			
8	Grade bonu	s compliant to §25	(2)				
9	References Will be anno	unced in the lecture	2				
Co	ırses						
	Course nr. 18-kl-1041-p	j Course name project Semina	ar Communicatior	and Sensor System	ns		
	Instructor Prof. DrIng	Ania Klein, M.Sc. S	umedh Dongare		Type Project se	eminar	SWS 4

Mo Pro	dule name iect Seminar	Communication and	Sensor Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	kp-1041	8 CP	240 h	180 h	1 Term	Every Seme	ester
Lan Ger	i guage man/English			Module owner Prof. Dr. techn. H	leinz Köppl		
1	Teaching co Investigating out of the re and structur summarizin conclusions	ontent g and solving specific ecent research topic ing of a seminar tasl g achieved results ar and defending them	problems concerni s of the research c, searching and a nd conclusions by in an oral discuss	ing communication group. Working o nalyzing of scienti means of a written ion including audie	and sensor system n a given task by fic reference public n report, presentin ence.	s Topics will be one's own, org ations for a giv g achieved resu	defined anizing en task, ılts and
2	 2 Learning objectives Upon successful completion of the module, students will be able to: the ability to apply methods of communication and sensor systems to practical problems deep and special knowledge in a particular field of communication and sensor systems the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report the ability to present and discuss achieved results in the form of a presentation in front of an audience 						
3	3 Recommended prerequisites for participation Previous knowledge in chosen discipline of communication and sensor systems						
4	Form of exa Module exa • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginnii	ng of the lecture	e.
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. und M.Sc. iST, B	.Sc. WI-etit				
8	Grade bonu	s compliant to §25	(2)				
9	References Will be anno	ounced in the lecture					
Coi	irses						
	Course nr. Course name 18-kp-1041-pi Project Seminar Communication and Sensor Systems						
	Instructor Prof. Dr. tecl	hn. Heinz Köppl			Type Project	seminar	SWS 4

Mo	dule name							
Pro	ject Seminar	Communication and	Sensor Systems					
Мо	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cy	cle
18-	pe-1041	8 CP	240 h	180 h	1 Term		Every Seme	ester
Lar	iguage man/English			Prof Dr-Ing Mai	rius Desave	ento		
1	Teaching co Investigating communicat will be defin organizing a given task, s results and o	ntent and solving specific ions engineering, mid ed out of the recent nd structuring of a s ummarizing achieve conclusions and defe	problems concernation crowave technolog research topics of ceminar task, search red results and con nding them in an	ing communication y, signal processing the involved labs) ching and analyzin clusions by means oral discussion incl	and sensor , sensor ne , working o g of scienti of a writte uding aud	r systems (etworks etc on a a give ific referen en report, ience.	Problems con c. are possible en task by one ce publication presenting ac	cerning e, topics e's own, ns for a chieved
2	 Learning objectives Upon successful completion of the module, students will be able to: the ability to apply methods of communication and sensor systems to practical problems deep and special knowledge in a particular field of communication and sensor systems (communications engineering), RF technology, signal processing, sensor networks the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report the ability to present and discuss achieved results in the form of a presentation in front of an audience 							
3	 Recommended prerequisites for participation Previous knowledge in chosen discipline, e.g. communication technology, signal processing, microwave technology, sensor networks 							
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/wrights of examinat	tten examination, I ion will be announ	Default RS) ced in the) beginning	of the lecture	e.
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Ed. etit, B.Sc. und M	I.Sc. iST, B.Sc. W	-etit				
8	Grade bonu	s compliant to §25	(2)					
9	References Will be anno	ounced in the lecture	:					
Co	urses							
	Course nr. 18-pe-1041-	pj Project Semina	ar Communicatior	and Sensor Syster	ns			
	Instructor Prof. DrIng	. Marius Pesavento, 1	M.Sc. Yufan Fan			Type Project se	eminar	SWS 4

Мо	dule name							
Pro	ject Seminar	Ferahertz Systems &	Applications					
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Hodule cyc	cle
Lan	p1-1020	4 Cr	120 11	Module owner	1 Ieiiii		Every Senie	
Ger	man/English			Prof. Dr. rer. nat.	Sascha Pro	eu		
1	 Treating content Investigating and solving specific problems concerning the development of Terahertz devices and systems as well as of applications of THz technology. The specific task will be defined based on current research topics. The project seminar includes working on a given task by one's own, organizing and structuring of a seminar task, searching and analyzing of scientific reference publications, summarizing achieved results and conclusions by means of a written report, presenting achieved results and conclusions and defending them in an oral discussion including audience. Topics include, e.g.: Optics on chip Semiconductor devicesLight-matter interaction 							
2	Learning of Upon succes • the abi • deep a • the ski • the cap presen	jectives sful completion of th lity to apply theoret nd special knowledg lls to find, analyze a pability to summariz t and discuss achieve	ne module, studen ical models to pra ge in a particular fi nd evaluate scient are the achieved sc ed results in the fo	ts were taught: ctical problems eld related to THz ific reference pape ientific findings in orm of a presentatio	science, oj rs for a pai the form o on in front	ptics or ser rticular top f a concise of an audi	niconductor j bic e reportthe al ience	physics pility to
3	Recommend Previous kno	led prerequisites fo wledge one of the fo	or participation	es: Optics, semicon	ductor phy	sics, or TH	Iz technology	
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/wrights type of examinat	tten examination, I ion will be announ	Default RS) ced in the) beginning	of the lecture	2.
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)					
9	9 References Will be announced once the topic is defined							
Cot	ırses							
	Course nr. 18-pr-1020-p	course name pj Project Semina	ar Terahertz Syste	ms & Applications				
	Instructor Prof. Dr. rer.	nat. Sascha Preu				Type Project se	eminar	SWS 2

Mo Pro	dule name ject Seminar (Communication and	Sensor Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	pr-1041	8 CP	240 h	180 h	1 Term	Every Seme	ester
Lar	iguage			Module owner	Sasaha Drou		
				FIOL DI. IEI. Hat.	Sascila Ficu		
1	Investigating out of the re and structur summarizin conclusions	and solving specific ecent research topic ing of a seminar tasl g achieved results an and defending them	problems concerni s of the research s, searching and a nd conclusions by in an oral discuss	ng communication group. Working o nalyzing of scienti means of a written ion including audie	and sensor systems. ' n a given task by or fic reference publicat n report, presenting ence.	Fopics will be ne's own, org tions for a giv achieved resu	defined anizing en task, ılts and
2	 2 Learning objectives Upon successful completion of the module, students will be able to: the ability to apply methods of communication and sensor systems to practical problems deep and special knowledge in a particular field of communication and sensor systems the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report the ability to present and discuss achieved results in the form of a presentation in front of an audience 						
3	3 Recommended prerequisites for participation Previous knowledge in chosen discipline of communication and sensor systems						
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture	e.
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)				
9	References Will be anno	ounced at the beginn	ing of the project.				
Coi	ırses						
	Course nr. 18-pr-1041-j	pj Course name Project Semina	ar Communication	and Sensor System	ms		
	Instructor Prof. Dr. rer.	nat. Sascha Preu			Type Project s	eminar	SWS 4

Mo	dule name	munications Draigat	T				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	sm-1030	8 CP	240 h	180 h	1 Term	Every Semester	
Lan	iguage			Module owner	f Stainmatz		
1	Tooching of	ntont		1101. DIIIIg. Rai	i Stellinetz		
	The course Besides a ge according to competencie • Netwo • Perfor • Discre • Protoc • Infrast • Contes • Peer-to • Contes • Multim • Web se • Adapti • Natura	deals with cutting-e neral overview, it pro- the specific working es in one or more of to ork planning and traff mance evaluation of the event simulation for ols for mobile ad hoor ructure networks for kt-aware communication opper systems and a nt distribution and m nedia authoring and ervice technologies and two educational technologies and the language processing on list of topics can be	dge development ovides a deep insig areas of the partic- the following topic fic analysis network application or network service c networks / sense mobile communi- tion and services rchitectures anagement system re-authoring tools nd service-oriente toologies ng in education found each seme	topics in the area ght into a special decipating researchers cs: ons es or networks cation / mesh networks cation / mesh networks d architectures	of multimedia com evelopment topic. Th s and convey technica vorks e-learning	munication systems. le topics are selected al and basic scientific	
	The concrete list of topics can be found each semester on the corresponding teaching website of KOM.						
2	Learning ol The ability to communicat among the f • Search • Design • Impler • Applic • Acquis • Evalua • Writin • Presen	ojectives o solve and evaluate to ion networks and ap ollowing: ning and reading of p n of communication a nenting and testing of ation of object-orient ition of project mana tion and analyzing o g of software document tation of project adv	technical problems plications using st project relevant lite pplications and pro- of software compo- t analysis and desi- agement technique of technical scienti entation and proje- ances and outcom	s in the area of desi tate of the art scien erature rotocols onents ign techniques es for small develop fic experiments ect reports tes	gn and development tific methods. Acqui	of future multimedia red competences are	
3	Recommend Keen interess nication syst • Basic e • Basic l • Knowl Centric	ded prerequisites for t to develop and expl tems. Further we exp experience in program knowledge in Object edge in computer co c Systems are recomm	or participation lore challenging so bect: mming Java/C# (0 oriented analysis ommunication net mended.	olutions and applica C/C++). and design. works. Lectures in	ations in cutting edge	e multimedia commu- tworks I and/or Net	
4	Form of exa Module exa • Modul Report and/ Prerequisite	mination n: e exam (Study achie or Presentation. The e for the award of c	vement, Oral/writ type of examinat redit points	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.	

I	Dessing the final	modulo anomination								
-		Grading								
6	Grading									
	Module exam:		100.0/)							
	• Module exa	am (Study achievement, Oral/written examination, weighting:	: 100 %)							
7	Usability of the	Usability of the module								
	B.Sc. etit, M.Sc.	B.Sc. etit, M.Sc. MEC, M.Sc. MedTec, B.Sc. und M.Sc. iST								
8	Grade bonus co	Grade bonus compliant to §25 (2)								
		_								
9	References	leferences								
	Each topic is cov	ach topic is covered by a selection of papers and articles. In addition we recommend reading of selected								
	chapters from fo	chapters from following books:								
	Andrew Ta	nenbaum: "Computer Networks". Prentice Hall PIR (ISBN 013	30384887)	р ·						
	• Raj Jain:	The Art of Computer Systems Performance Analysis: Techni	ques for Experimental	Design,						
	Measureme	ent, Simulation, and Modeling" (ISBN 0-471-50336-3)		1						
	• Erich Gam	ma, Richard Helm, Ralph E. Johnson: "Design Patterns: Object	cts of Reusable Object C	Iriented						
	Software" (ISBN 0-201-63361-2)	10,000,0001000(54)							
	• Kent Beck:	"Extreme Programming Explained - Embrace Changes" (ISBN-	-13: 9/8-03212/8654)							
Co	17000									
	ui 5C5									
	Course nr.	Course name								
	18-sm-1030-pj Multimedia Communications Project Seminar I									
	Instructor Type SWS									
	Prof. Dr. rer. nat	. Björn Scheuermann, Dr. Ing. Julian Zobel, M.Sc. Fridolin	Project seminar	4						
	Siegmund Prof	Dr-Ing Ralf Steinmetz								

Mo Pro	dule name iect Seminar I	electromagnetic CAI)					
Mo 18-	dule nr. sc-1020	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module d	luration	Module cyc Every Seme	cle ester
Lar Ger	iguage man/English		l	Module owner Prof. Dr. rer. nat.	Sebastian	Schöps		
1	Teaching co Work on a pu Topics of go algorithms a	ntent roject in numerical f od scientific practic re addressed in an a	ield calculation us e, as well as socie accompanying mar	ing commercial too tal or ethical aspe mer, where technic	ols or own s cts of prod cally approp	software. uct design priate.	n, optimizatio	on, and
2	2 Learning objectives Students will be able to simulate engineering problems with numerical field simulation software. They are able to estimate modelling and numerical errors. They know how to present the results on a scientific level in talks and a paper. Students are able to organize teamwork.							
3	3Recommended prerequisites for participationGood understanding of electromagnetic fields, knowledge about numerical simulation methods.							
4	Form of exa Module exar • Module Report and/o	mination n: e exam (Study achie or Presentation. The	vement, Oral/write type of examinat	tten examination, I ion will be announ	Default RS) ced in the l	beginning	of the lecture	е.
5	Prerequisite Passing the f	for the award of c inal module examin	redit points ation					
6	Grading Module exam • Module	n: e exam (Study achie	evement, Oral/writ	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, M	the module Sc. etit - SAE, M.Sc	. WI-etit, M.Sc. CI	E, B.Sc. CE, M.Sc. I	MedTec, M.	.Sc. iCE		
8	Grade bonu	s compliant to §25	(2)					
9	References Documents v	vill be made availab	le via Moodle if ne	ecessary.				
Coi	urses							
	Course nr. 18-sc-1020-p	j Course name project Semin	ar Electromagneti	c CAD				
	Instructor Prof. Dr. rer.	nat. Sebastian Schö	ops			Type Project se	eminar	SWS 4

Mo Pro	dule name ject Seminar I	Energy Information	Systems - Comput	er Engineering			
Mo 18-	dule nr. st-1010	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration 1 Term	Module cy Every Seme	cle ester
Lar Ger	iguage rman			Module owner Prof. Dr. rer. nat.	Florian Steinke	<u>.</u>	
1	Teaching co Students ela documentat solutions to	ntent borate on a researc on and/or a presen a given problem.	ch-oriented subjec tation of the acqu	t in the area of co ired advanced kno	mputer-systems. Th wledge. They provid	ey present a le a set of alte	written ernative
2	2 Learning objectives After successful completion of the module, students have learned how to acquire and summarize basic knowledge (literature, terminology) on a research-oriented topic. They have learned to systematically work out alternative solutions to a posed problem from the field of energy information systems/data technology.						
3	Recommend	led prerequisites fo	or participation				
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	evement, Oral/wri e type of examinat	tten examination, l ion will be announ	Default RS) ced in the beginning	g of the lecture	e.
5	Prerequisite Passing the f	e for the award of c inal module examin	e redit points ation				
6	Grading Module exar • Modul	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)				
9	References						
Cot	urses						
	Course nr. 18-st-1010-p	j Course name Project Semin	ar Energy Informa	tion Systems - Con	nputer Engineering		
	Instructor Prof. Dr. rer.	nat. Florian Steinke	2		Type Project s	eminar	SWS 4

Mo	dulo nomo							
Pro	ject Seminar I	Energy Information	Systems - Electrica	l Power Engineerir	ıg			
Mo 18-	dule nr. st-1040	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module du 1 Term	uration	Module cy Every Seme	cle ester
Lar Ger	iguage man			Module owner Prof. Dr. rer. nat.	Florian Ste	inke	-	
1	Teaching co Students ela lab. They pro provide a set	ntent borate on a researc esent a written docu of alternative solut	h-oriented subject imentation and/o ions to a given pro	in the area of the r a presentation of blem.	energy info the acquire	ormation and advance	networks & s ed knowledg	systems e. They
2	2 Learning objectives After successful completion of the module, the students have learned how to acquire basic knowledge (liter- ature, terminology) on a research-oriented topic and present it in a summarized form. They have learned to systematically work out alternative solutions to a given problem from the field of energy information systems.							
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exar • Module Report and/o	mination n: e exam (Study achie or Presentation. The	evement, Oral/writ e type of examinat	tten examination, I ion will be announ	Default RS) ced in the b	eginning	of the lecture	e.
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 1	100 %)		
7	Usability of B.Sc. etit	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	ırses							
	Course nr. 18-st-1040-p	j Course name Project Semin	ar Energy Informa	tion Systems - Elec	ctrical Power	r Enginee	ring	
	Instructor Prof. Dr. rer.	nat. Florian Steinke	2			Type Project se	eminar	SWS 3

Mo Pro	dule name jektseminar S	Software Systems					
Mo	dule nr. su-1060	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration	Module cycle Every Semester	
Lar Ger	nguage man			Module owner Prof. Dr. rer. nat.	Andreas Schürr		
1	 Teaching content The course deals with various development and research topics in the area of model-driven engineering and object-oriented software engineering. Besides a general overview, it provides a deep insight into a special scientific topic. The topics are selected according to the specific working areas of the participating researchers and convey technical and scientific competences in one or more of the following topics: Model-Driven Enginnering and Model Synchronization Model Transformation Object-Oriented Refactorings Program Variability (Software Product Lines) Feature Model Analysis 						
2	 Learning objectives The student gains practical experience in development (reengineering and maintenance) of complex software systems. He/She learns to work and function in a team, and to analyze and solve a non- trivial task. Moreover, students exercise using theoretical knowledge in the group (e.g. from lectures like software engineering - introduction / Design / Maintenance & Quality Assurance) to solve a concrete and practical problem. Students that have successfully completed this seminar are able to independently organize and set-up a non-trivial software project and function to analyze and solve a certain task. Attendees gain the following skills in detail:						
3	Recommen Basic softwa	ded prerequisites for are technology knowl	or participation edge and advance	d knowledge of ob	ject-oriented program	nming languages	
4	Form of exa Module exa • Modul Report and/	amination m: le exam (Study achie ⁄or Presentation. The	vement, Oral/wrights of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.	
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	Grading Module exa • Modul	m: le exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of B.Sc. etit, M	f the module I.Sc. WI-etit, M.Sc. C	E, B.Sc. CE, B.Sc.	und M.Sc. iST			
8	Grade bonu	is compliant to §25	(2)				
9	References www.es.tu-darmstadt.de/lehre/aktuelle-veranstaltungen/ps-softwaresysteme/						
Coι	urses						

Course nr. 18-su-1060-pj	Course name Projektseminar Software Systems		
Instructor M.Sc. Hendrik G	öttmann, Prof. Dr. rer. nat. Andreas Schürr	Type Project seminar	SWS 4

Мо	dule name							
Pro	ject Seminar	Communication and	Sensor Systems					
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle
18-	zo-1041	8 CP	240 h	180 h	1 Term		Every Seme	ester
Lan Ger	iguage man/English			Prof Dr-Ing Abc	lelhak Zou	hir		
1	1 Teaching content Investigating and solving specific problems concerning communication and sensor systems (Problems concerning communications engineering, microwave technology, signal processing, sensor networks etc. are possible, topics will be defined out of the recent research topics of the involved labs), working on a a given task by one's own, organizing and structuring of a seminar task, searching and analyzing of scientific reference publications for a given task, summarizing achieved results and conclusions by means of a written report, presenting achieved results and conclusions and defending them in an oral discussion including audience.							
2	 Learning objectives Upon successful completion of the module, students will be able to: the ability to apply methods of communication and sensor systems to practical problems deep and special knowledge in a particular field of communication and sensor systems (communications engineering), RF technology, signal processing, sensor networks the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report the ability to present and discuss achieved results in the form of a presentation in front of an audience 							
3	Recommended prerequisites for participation Previous knowledge in chosen discipline, e.g. communication technology, signal processing, microwave technol- ogy, sensor networks							
4	Form of exa Module exa • Modul Report and/	m ination n: e exam (Study achie or Presentation. The	vement, Oral/wrights type of examinat	tten examination, I ion will be announ	Default RS) ced in the) beginning	of the lecture	2.
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. und M.Sc. iST, B	S.Sc. WI-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References Will be anno	ounced in the lecture						
	Course nr. 18-zo-1041-	Course name	ar Communication	and Sensor System	ns			
	Instructor Prof. DrIng	. Abdelhak Zoubir				Type Project se	eminar	SWS 4

Mo Pro	dule name duct Develop	ment Methodology I						
Мо	dule nr.	Credit points	Workload	Self-study	Module of	duration	Module cy	cle
18-	sa-1010	8 CP	240 h	180 h	1 Term		Winter tern	n
Lar Ger	n guage man			Module owner Prof. Dr. Mario K	upnik			
1	Teaching co Practical exp	ontent perience in the metho	ods used for the d	evelopment of tech	nical prod	ucts. Work	in a project	team.
2	After successful completion of the modul, students are able to apply development methodologies to a concrete development project in a team. They can create a schedule, analyze the state of the art, write a list of requirements, abstract a task and work out sub-problems. They can search for solutions using different solution methods, develop optimal solutions using evaluation methods and derive a reaonable overall concept. The students have learned to derive the required parameters needed by calculation and modeling. They can create manufacturing documentation with all necessary documents such as parts lists, technical drawings and circuit diagrams, carry out the construction and examination of a laboratory sample and reflect retrospectively on the development carried out.							
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation. The type of examination will be appounced in the beginning of the lecture. 							
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	m: e exam (Study achie	vement, Oral/writ	tten examination, V	Veighting:	100 %)		
7	Usability of B.Sc. etit, B.	the module Sc. MEC, M.Sc. MEC	C, B.Ed. etit, B.Sc.	und M.Sc. iST, B.S	sc. WI-etit			
8	Grade bonu	is compliant to $\S{25}$	(2)					
9	References Script: Deve	lopment Methodolog	gy (PEM)					
Coi	urses							
	Course nr. 18-sa-1010-	pj Product Devel	opment Methodol	ogy I				
	Instructor Prof. DrIng Hinrichs, M. Burg, DrIng	g. Tran Quoc Khanl Sc. Dominik Großkur g. Ferdinand Keil	n, Prof. DrIng. 1 th, Prof. Dr. Mario	Klaus Hofmann, M Kupnik, Prof. Ph.D	.Sc. Jan .Thomas	Type Project se	eminar	SWS 4

Mo	dule name							
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cv	cle
18-	sa-1020	5 CP	150 h	105 h	1 Term		Summer ter	rm
Lar Ger	n guage rman			Module owner Prof. DrIng. Kla	us Hofmar	n		
1	Teaching co Practical exp teamwork, w team and or	ontent periences by using n erbal and written rep ganize the developm	nethodical proced presentation of res lent process indep	ures in the develop sults and the organ endently.	pment of t ization of t	technical p developme	roducts. In a nt. Work in a	ddition project
2	2 Learning objectives Applying the development methodology to a specific development project in a team. To do this, students can create a schedule, can analyze the state of the art, can compose a list of requirements, can abstract the task, can work out the sub-problems, can seek solutions with different methods, can work out optimal solutions using valuation methods, can set up a final concept, can derive the parameters needed by computation and modeling, can create the production documentation with all necessary documents such as bills of materials, technical drawings and circuit diagrams, can build up and investigate a laboratory prototype and can reflect their development in retrospect.							
3	Recommended prerequisites for participation Product Development Methodology I							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Beport and/or Presentation. The type of examination will be appounded in the beginning of the lecture 							
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exame Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of B.Sc. etit, M	the module .Sc. MEC, M.Sc. Med	dTec, B.Ed. etit, B	.Sc. und M.Sc. iST,	B.Sc. WI-	etit		
8	Grade bonu	s compliant to §25	(2)					
9	References Script: Deve	lopment Methodolog	gy (PEM)					
Co	urses							
	Course nr. 18-sa-1020-j	Course name pj Product Develo	opment Methodol	ogy II				
	Instructor Prof. DrIng Kupnik, Prof	. Tran Quoc Khanh, . Ph.D. Thomas Burg	Prof. DrIng. Klau	ıs Hofmann, Prof. I	Dr. Mario	Type Project se	eminar	SWS 3

1.6 Modules of the B.Sc. Biomedical Engineering

Please note that the modules of the Biomedical Engineering degree programs can only be selected by students of Biomedical Engineering.

Mo Me	Module name Medizinische Morphologie, Terminologie und Angewandte Anatomie I							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18-1	mt-1011	3 CP	90 h	60 h	1 Term	Winter term		
Lan Ger	iguage man			Module owner Prof. Dr. Thomas Vogl				
1	The module deals with the fundamentals of the morphology of the human body, its tissue structures and their relationships. Basic terminology for naming human anatomy is discussed. Superordinate systemic functional principles within the human body are explained. Basic techniques for representing the human body are presented. The anatomy of the human organs, including the musculoskeletal system, the cardiovascular system, the vascular system and the respiratory tract are discussed, in particular. Anatomical structures and functional relationships are explained on the basis of common clinical cases and thus a direct clinical reference is established. In addition, the participants gain initial knowledge of the organizational structures of diagnostic processes. On the basis of a discussion of medical methods and theoretical approaches in operative disciplines, the participants acquire knowledge on crucial medical issues.							
2	2 Learning objectives After successfully completing the module, students are familiar with the basics of medical terminology and the shape and structure of the human body. They are also familiar with different media for obtaining information about the morphology of the body and can assess the medias' differential diagnostic reliability. The students are familiar with the basics of the anatomy of important body systems. In addition, the students know important clinical pathologies, can explain them in diagnostics and therapy using examples and discuss them with medical specialists as well as laypersons.							
3	Recommend	ded prerequisites fo	or participation					
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	camination, Exam	ination, Duration:	60 Min., Default RS)			
5	Prerequisite Passing the f	e for the award of c final module examina	redit points ation					
6	Grading Module exar • Modul	n: e exam (Technical ex	amination, Exam	ination, Weighting:	: 100 %)			
7	Usability of B.Sc. MedTe	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							

- Caspar: Medizinische Terminologie, Thieme Verlag
- Schünke/Schumacher/Schulte: Prometheus Lernpaket Anatomie, Thieme Verlag
 Vogl: Diagnostische und Interventionelle Radiologie, Springer Verlag
 Menche: Biologie, Anatomie, Physiologie; Elsevier Verlag

- Supplementary material

Courses

Course nr. 18-mt-1011-iv	Course name Medizinische Morphologie, Terminologie und Angewandte A	natomie I	
Instructor Prof. Dr. Thomas	Vogl	Type Integrated course	SWS 2

Mo	dule name	rphologie Terminolo	ogie und Angewar	dte Anatomie II			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	mt-1012	3 CP	90 h	60 h	1 Term	Summer term	
Gei	rman			Prof. Dr. Thomas	Vogl		
1	 Teaching content The module deals with the fundamentals of the morphology of the human body, its tissue structures and their relationships. In particular, the anatomy of the human organs is discussed including the functioning of the lungs, the sensory systems, the digestive system and the nervous system. This also includes the knowledge transfer of medical terminology. Anatomical structures and functional relationships are explained on the basis of common clinical cases and thus a direct clinical reference is established. At the same time, the module discusses methods and devices that can be used to represent the anatomy and functions of the body, such as medical imaging. In addition, the participants gain initial knowledge of the organizational structures of diagnostic processes. On the basis of a discussion of medical methods and theoretical approaches in operative disciplines, the participants acquire knowledge on crucial medical issues. Learning objectives 						
2	2 Learning objectives Students who have successfully completed this module are familiar with the basics of the anatomy of important body systems and have acquired a deeper understanding of common medical problems, especially in the field of surgery and internal medicine. They are familiar with medical terminology and understand the most important and most common medical terms. In addition, the students know important clinical pathologies, can explain them in diagnostics and therapy using examples and discuss them with medical specialists as well as with laypersons.						
3	Recomment Module "Me	ded prerequisites fo dical Morphology, Te	or participation erminology and Ap	oplied Anatomy I"			
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	amination, Exam	ination, Duration:	60 Min., Default RS)		
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Technical ex	amination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. MedTe	the module					
8	Grade bonu	s compliant to §25	(2)				
9	References Caspar Schün Vogl: I Mench Supple	:: Medizinische Term ke/Schumacher/Sch Diagnostische und In e: Biologie, Anatomi ementary material	inologie, Thieme ulte: Prometheus terventionelle Rac e, Physiologie; Els	Verlag - Lernpaket Anator liologie, Springer V sevier Verlag	nie, Thieme Verlag ⁄erlag		

Course nr. 18-mt-1012-iv	Course name Medizinische Morphologie, Terminologie und Angewandte A	natomie II	
Instructor Prof. Dr. Thomas	Vogl	Type Integrated course	SWS 2

Mo Cel	dule name l Biology and	Physiology for Medie	cal Technology I				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	n Module cy	cle
18-1	mt-1021	- 3 CP	90 h	45 h	1 Term	Winter terr	n
Lan	iguage			Module owner	leming		
1	Translation and			1 Ioi. Di. iligita i	leming		
I	This module deals with biological, biochemical and physiological principles that form the basis for the application of engineering methods to living systems in medicine and dentistry. The basics of terminology, cell biology, biochemistry and physiology as well as the principles of physiological and biochemical processes in the human body are taught. In this specific course, basic processes of neuro-, muscle- and cardiovascular physiology are in focus. In parallel, the students are presented with analytical and simple diagnostic procedures linked with common metabolic and organ-specific diseases. Within the framework of the courses, pathophysiological changes leading to common diseases will be presented and discussed to provide a direct link to the clinical situation.						
2	Learning objectives Students who have successfully completed this module can understand the biological, biochemical and physio- logical relationships and apply these to the development and evaluation of biomedical diagnostic and therapeutic systems. Furthermore, due to their understanding of cellular and molecular biological processes acquired in this module, students should be prepared to discuss medical content with medical professionals and laypersons as well as to understand basic biomedical literature.						
3	Recommended prerequisites for participation						
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default R	S)	
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exar • Modul	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of B.Sc. MedTe	the module c					
8	Grade bonu	s compliant to §25	(2)				
9	9 References Menche: Biologie Anatomie und Physiologie, Elsevier-Verlag Accompanying materials						
Co ι	irses						
	Course nr. 18-mt-1021-	iv Cell Biology at	nd Physiology for	Medical Technolog	y I		
	Instructor Prof. Dr. Ing	rid Fleming			Type Integra	ited course	SWS 3

Мо	dule name							
Cel	l Biology and	Physiology for Medie	cal Technology II	0.10 . 1		26.1.1		
Mo	dule nr. mt-1022	Credit points	Workload 90 h	Self-study 45 h	Module duration	Summer te	cle	
Lar Ger	nguage man		70 H	Module owner Prof. Dr. Ingrid Fleming				
1	Teaching co Building on Technology provided ins and metabol relevant to c	ontent the basic biochemical 1", the more comple- ight into the perform ism. Building on this common clinical cond	and physiological ex topics of integr nance of the huma , the students are i litions and thus of	topics in the modul rative and sensory an sensory organs a introduced to some clinical relevance.	le "Cell Biology and P physiology are taug and the principles of pathophysiological fu	hysiology for ht. Students hormonal reg inctional corr	Medical will be gulation elations	
2	2 Learning objectives After successful completion of this module, students should be able to understand basic physiological relationships and apply these to the development and evaluation of biomedical diagnostic and therapeutic systems. On the basis of their understanding of the function of the sensory organs and processes acquired in this module, students should be able to discuss medical content with medical professionals and laypersons, as well as to understand basic biomedical literature.							
3	Recommended prerequisites for participationModule "Cell Biology and Physiology for Medical Technology I"							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 							
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of B.Sc. MedTe	the module						
8	Grade bonu	s compliant to §25	(2)					
9	 References Mensche: Biologie Anatomie und Physiologie, Elsevier-Verlag Accompanying materials 							
Coi	urses							
	Course nr. 18-mt-1022-	iv Cell Biology an	nd Physiology for	Medical Technolog	y II			
	Instructor Prof. Dr. Ing	rid Fleming			Type Integrate	ed course	SWS 3	

Mo Bio	dule name mechanics an	d Biomaterials					
Mo 18-	dule nr. mt-1030	Credit points 6 CP	Workload 180 h	Self-study 90 h	Module duration	Module cycle Winter term	
Lar Ger	iguage man			Module owner Prof. Dr. Ingo Marzi			
1	 Teaching content This module deals with the basics of biomechanics. Basis for this is the anatomy of the musculoskeletal system. Among these is integrated the introduction into rigid bodies, multi-body models of human body parts, different modeling variants or the determination of the reaction forces and moments in human joints. In addition, this module deals with material sciences for considering the human body and with materials that are used in particular in medical technology. These include medical-grade materials used to make implants that remain temporarily or permanently in the body, as well as biomaterials used to replace body tissues (skin, bones, cartilage, etc.). In the areas of biomechanics and biomaterials, the basics of osteosynthesis techniques with implants and endoprosthetics are presented as well as basic principles of tissue engineering in the fields of medicine and dentistry. Learning objectives 						
2	2 Learning objectives After successfully completing this module, students gain knowledge and understanding of the biomechanical basis of human body functions. They shall be able to independently and critically use biomechanical methods. Students are familiar with the basic materials and their mechanical and biological properties used in the human body. In particular, students are familiar with the requirement profile for material behavior regarding medical engineering. They are able to independently select materials for an application from medical engineering, to assess their advantages and disadvantages and to explain them in an argumentative manner.						
3	Recommended prerequisites for participation "Terminology, Medical Morphology and Applied Anatomy"						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) Note: one exam per course 						
5	Prerequisite Passing of Te	e for the award of c echnical examination	redit points				
6	Grading Module exan • Modul • Modul	n: e exam (Technical ex e exam (Technical ex	xamination, Exam xamination, Exam	ination, Weighting ination, Weighting	: 50 %) : 50 %)		
7	Usability of B.Sc. MedTe	the module					
8	Grade bonu	is compliant to §25	(2)				
9 Сот	References Sommerfeld Frobin, Brin Grifka, Krän Hausamen: Epple: Biom Curtis, Wats Irses	, Klein: Biomechanik ckmann, Leivseth: M ner: Orthopädie-Unfa Mund-Kiefer-Gesicht aterialien und Biomi on: Dental Biomateri	c der menschlicher Iusculosceletal Bio allchirurgie, Sprin schirurgie, Elsevie neralisation, Sprin ials, Elsevier-Verla	n Gelenke, Elsevier omechanics, Thiemo ger-Verlag er-Verlag nger Verlag g	-Verlag e Verlag		

Course nr. 18-mt-1030-iv	Course name Biomechanics		
Instructor Prof. Dr. Ingo Ma	ırzi	Type Integrated course	SWS 3
Course nr.Course name18-mt-1031-ivBiomaterials			·
Instructor Prof. Dr. Ingo Ma	ırzi	Type Integrated course	SWS 3

Mo Bio	dule name medizinische	Technik						
Mo	dule nr. mt-1041	Credit points	Workload 90 h	Self-study 45 h	Module dur	ation	Module cyc Winter tern	cle
Lar Ger	nguage man	0.01		Module owner Prof. Dr. Dr. Kai 2	Zacharowski			
1	Teaching co Biomedical e therapy. Thi disciplines co the field of d and function process, the be comprehe	entent engineering supports s module focuses on omplement the progr evice technology are nal processes in the implementation of s ended using practica	s medicine with te possible application ramme at times. In taught, taking into human body are of cientific questions l examples.	chnical solutions ir ons in the fields of a particular, curren o account the under liscussed in the co from the basic are	n the areas of anaesthesiolo t research and lying biotechr ntext of comm a and theory i	preventi ogy and l develop nology. I non clin into clin	ion, diagnost radiotherapy pment projec n addition, a ical pictures ical applicati	ics and 7. Other its from natomy . In the ion will
2	2 Learning objectives After successful completion of the module, the students have gained insights into the implementation and application of device medical technology and biotechnological processes in application. They are informed about the current R&D status of medical device technology and special biotechnology. In addition, they can independently apply their acquired knowledge to interdisciplinary issues of medicine and engineering sciences and thus formulate subject-related positions.							
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	60 Min., Defa	ult RS)		
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Technical ez	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of B.Sc. MedTe	the module c						
8	Grade bonu	s compliant to §25	(2)					
9	References Leonhardt, technical art	Steffen, Walter, Ma icles on the various o	rian: Medizintecl clinical fields of ap	nnische Systeme, s pplication, Accompa	Springer-Verla anying materi	ag, relev als.	vant textboo	oks and
Coι	ırses							
	Course nr. 18-mt-1041-	iv Biomedizinisc	he Technik					
	Instructor Prof. Dr. Dr.	Kai Zacharowski			Ty In	/ pe tegrated	l course	SWS 3

Мо	dule name							
Bio	sensorik und B	ildgebung	Monthleed	Colf atra day	Madula	dunation	Madula	
18-	mt-1042	4 CP	120 h	60 h	1 Term	uuration	Summer ter	rm
Lar Ger	iguage man		1	Module owner Prof. Dr. Dr. Kai Z	Zacharows	ki	I	
1	Teaching con The Biosenso the anatomy and image pu the various d interventiona focus is on the minimally inv	ntent rs and Imaging moo and functions of the rocessing, such as s evices and procedu l procedures, in whi e presentation and a vasive body function	dule focuses in par le body. Emphasis egmentation, filte res are presented ch invasive work is application of intra ns are detected an	ticular on methods is placed on unde oring and image rea in a problem-orien carried out on the corporeally applied d influenced.	and devic rstanding constructic ted manne patient wit sensory an	es that can and applyi on. The use er. This also th imaging nd actuator	be used to v ng medical in and signific includes the support. The r systems with	isualise maging ance of e use of second h which
2	After successful completion of the module, the students have gained insights into the implementation and application of device medical technology and biotechnological processes in application. They are informed about the current R&D status of medical device technology and special biotechnology. In addition, they can independently apply their acquired knowledge to interdisciplinary issues of medicine and engineering sciences and thus formulate subject-related positions.							
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation					
6	Grading Module exam • Module • Module	l: exam (Technical e: exam (Technical e:	xamination, Exam xamination, Exam	ination, Weighting ination, Weighting	: 50 %) : 50 %)			
7	Usability of t B.Sc. MedTec	the module						
8	Grade bonus	compliant to §25	(2)					
9	 References Leonhardt, Steffen, Walter, Marian: Medizintechnische Systeme, Springer-Verlag, relevant textbooks and technical articles on the various clinical fields of application, Unterrichtsbegleitende Materialien. 							
Co	urses	_						
	Course nr. 18-mt-1042-i	v Biosensors and	d imaging					
	Instructor Prof. Dr. Dr. I	Kai Zacharowski				Type Integrate	d course	SWS 2

Course nr. 18-mt-1043-iv	Course name Bildgebung		
Instructor Prof. Dr. Thomas	Vogl, Prof. Dr. Dr. Kai Zacharowski	Type Integrated course	SWS 2

Mo	dule name	Courses					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
Lar	nguage man	0.01	100 11	Module owner Prof. Dr. Dr. Robe	ert Sader	Winter terr	
1	Teaching co In small groudisciplines a limitations of learn the cli	ontent ups, students have th nd to experience the of the device technolo nical communication	e opportunity to p use of medical dev ogies. They partici channels, workflo	participate in the ev vices in daily use as pate in various eve ows and treatment	eryday clinical practi well as to experience ryday clinical situati strategies.	ice of various e the possibili ons in a hosp	medical ties and ital and
2	Learning ol Students kn understand They are fan current state	ojectives low the day-to-day with the terminology and niliar with a wide rar e of development of p	work of a physici l "language" of a r nge of applications medical devices.	an and the comm nedical doctor and of medical devices	unication structures can communicate w and products and ar	of a hospital vith them suff re informed al	l. They ficiently. bout the
3	 Recommended prerequisites for participation "Terminology, Medical Morphology and Applied Anatomy" and " Natural Scientific Principles for Medical Engineering" und "Biomedical Engineering". As well as being vaccinated against measles, mumps, varicella, tetanus and hepatitis B according to the recommendation of the Standing Committee on Vaccinations. 						
4	 Form of examination Module exam: Module exam (Technical examination, Report, p/np RS) After course II the examinee compiles a two-page summary of a medical device, describing functional principle and possible applications but also its limitations in the medical field 						
5	Prerequisite Passing of Te	e for the award of c	redit points				
6	Grading Module exame Modul	n: e exam (Technical ex	xamination, Repor	rt, Weighting: 100	%)		
7	Usability of B.Sc. MedTe	the module					
8	Grade bonu	is compliant to §25	(2)				
9	References						
Co	ırses						
	Course nr. 18-mt-1120-	-pr Clinical Practic	cal Courses I				
	Instructor Prof. Dr. Dr.	Robert Sader			Type Lab		SWS 2
	Course nr. 18-mt-1121-	-pr Clinical Practic	cal Courses II				
	Instructor Prof. Dr. Dr.	Robert Sader			Type Lab		SWS 2

Mo Me	dule name dical Law. For	ensic Medicine and l	Ethics					
Мо	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cyc	cle
18-	mt-1140	3 CP	90 h	60 h	1 Term		Summer ter	rm
Lar Ger	nguage rman			Module owner Prof. Dr. Markus	Parzeller			
1	Teaching co This module these the mo law (TPG)) a It will also co research on	ontent deals with the legal edical drug law (AM and practical aspects over the basics of me humans and the dev	foundations of the G), the Civil Code of the forensic me dical ethics and bi elopment of medi	(inter-) national h (BGB), the medica edicine (e.g. Forens oethics, which will cal technologies in	ealth syste: al device la ic toxicolog give a clos a legal-eth	m and the aw (MPG), gy, Forensid er look to t ical contex	medical law the transpla DNA, thana the ethical asj	(among ntation tology). pects of
2	Learning of Upon succes current case and (bio) me that take int	ojectives ssful completion of law in context of m edicine, including act o account social, leg	this module, stude edical law and me ual and future rese al, scientific, ethica	ents are sensitized dical technology ar earch projects. The al and practical kno	to legal a nd ethical a y can derive wledge esp	nd (forens aspects in t e scientifica pecially for	ic) medicine medical engir ally based jud medical tech	e issues, neering gments inology.
3	Recomment None	ded prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisite Passing of M	e for the award of c odule final exam	redit points					
6	Grading Module exan • Modul	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of B.Sc. MedTe	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References Legal commo from legal d	entariestextbooks and atabases, ethic basic	d publications of re literature.	levant areas of law	and of fore	nsic medic	ine, current c	ase-law
Coi	urses							
	Course nr. 18-mt-1140-	vl Medical Law, 1	Forensic Medicine	and Ethics				
	Instructor Prof. Dr. Ma	rkus Parzeller				Type Lecture		SWS 2

1.7 Mandatory modules of B.Sc. programs from other departments

Mo Ma	dule name thematics I (El	ectrical Engineering	5)					
Mo 04-	dule nr. 00-0108	Credit points 8 CP	Workload 240 h	Self-study 150 h	Module d 1 Term	uration	Module cy Winter tern	cle n
Lar Gei	iguage rman			Module owner Apl. Prof. Dr. rer.	nat. Steffe	n Roch		
1	Teaching con Basics, real a integral calcu linear equation	n tent nd complex number ilus in one variable, ons	rs, real funktions, vector spaces, lin	continuity, differen ear mappings, syste	itial and ems of			
2	Learning ob	jectives						
3	Recommend	ed prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam: Module exam (Technical examination, Oral/written examination, Default RS) Usually the exam is taken in form of a written test (90 min), except when there are only a small number of potential participants. In this case, the exam can be taken in the form of an oral exam (30 min). The decision about the form of the exam is taken and communicated during the first two weeks of the lecture, based on the prospective number of students taking the exam. Prerequisite for the award of credit points 							
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exam • Module	n: e exam (Technical e:	xamination, Oral/	written examinatio	on, Weightir	ıg: 100 %)	
7	Usability of Für B.Sc.ETi	t he module Г, B.Ed.ETiT, B.Sc.W	/IETiT, B. Sc. Mec	, B. Sc. CE, B. Sc. I	ST, B. Sc. N	/ledTech		
8	Grade bonus	s compliant to §25	(2)					
9	References							
Co	urses							
	Course nr. 04-00-0126-v	Course name ru Mathematics I	(Electical Engine	ering)				
	Instructor Apl. Prof. Dr.	rer. nat. Steffen Ro	ch			Type Lecture a	nd practice	SWS 6

Mo	dule name	lastrical Engineerin	c)				
Ma	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
04-	00-0109	8 CP	240 h	150 h	1 Term	Summer te	rm
Lar Ger	iguage man			Module owner Apl. Prof. Dr. rer.	nat. Steffen Roch		
1	Teaching co Determinant Taylor and Fe and implicit	ntent s, eigenvalues, quad ourier series, differe functions, path integ	ratic forms, seque ntiala calculus in I grals, integration i	ences and series of R^n, extrema, inve in R^n	functions, rse		
2	Learning ob	jectives					
3	Recommend Recommend	l ed prerequisites fo ed: Mathematik I (fi	or participation ir ET)				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Default RS) Usually the exam is taken in form of a written test (90 min), except when there are only a small number of potential participants. In this case, the exam can be taken in the form of an oral exam (30 min). The decision about the form of the exam is taken and communicated during the first two weeks of the lecture, based on the prospective number of students taking the exam. 						
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exam • Module	n: e exam (Technical ex	xamination, Oral/	written examinatio	on, Weighting: 100 %)	
7	Usability of B.Sc.ETiT, B.	the module Ed.ETiT, B.Sc.WIET	iT, B. Sc. Mec, B.	Sc. CE, B. Sc. IST,	B. Sc. MedTech		
8	Grade bonu	s compliant to §25	(2)				
9	References						
Coi	urses						
	Course nr. 04-00-0079-	Course name Vu Mathematics I	I (Electrical Engin	eering)			
	Instructor Apl. Prof. Dr.	rer. nat. Steffen Ro	ch		Type Lecture a	nd practice	SWS 6

Mo	dule name	Tlastrian Engineeri					
Ma	dule nr.	Credit points	Workload	Self-study	Module duration	Module cv	cle
04-	00-0111	8 CP	240 h	150 h	1 Term	Winter tern	n
Lar Ger	iguage man			Module owner Apl. Prof. Dr. rer.	nat. Steffen Roch		
1	Teaching co integral calc equations: li of solutions, coefficients, differentiation series, residu	ontent ulus: surface integra near and non-linear elementary techniqu Laplace transform; (on, Cauchy's integral ues, residue theorem	ls, integral theore differential equat les, linear systems Complex Analysis: formula, power s	ms; ordinary differ ions, existence and s with constant complex functions eries and Laurent	rential uniqueness s, complex		
2	Learning of	ojectives					
3	Recommend Recommend	led prerequisites fo ed: Mathematik I ur	or participation ad Mathematik II ((für ET)			
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Default RS) Usually the exam is taken in form of a written test (90 min), except when there are only a small number of potential participants. In this case, the exam can be taken in the form of an oral exam (30 min). The decision about the form of the exam is taken and communicated during the first two weeks of the lecture, based on the prospective number of students taking the exam. 						
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Technical e:	xamination, Oral/	written examinatio	on, Weighting: 100 %	b)	
7	Usability of B.Sc.ETiT, B	the module .Ed.ETiT, B.Sc.WIET	iT, B. C. MedTech	, B.Sc.MEC, B.Sc.C	E, B.Sc.IST		
8	Grade bonu	s compliant to §25	(2)				
9	References						
Coi	ırses						
	Course nr. 04-00-0127-	Course namevuMathematics I	II (Electrical Engi	neering)			
	Instructor Apl. Prof. Di	. rer. nat. Steffen Ro	ch		Type Lecture a	and practice	SWS 6

Mo	dule name	lity Theory						
Mo	dule nr. 10-0602	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module of 1 Term	duration	Module cyc	cle rm
Lar Ger	nguage rman			Module owner Prof. Dr. rer. nat.	Stefan Ull	orich		
1	Teaching co	ntent		1				
2	Learning ob	jectives						
3	Recommend	ed prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 							
5	Prerequisite for the award of credit points Passing the final module examination							
6	Grading Module exam • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of	the module						
8	Grade bonus	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 04-10-0602-v	Course name //u Statistics/Prob	ability Theory					
	Instructor					Type Lecture a	nd practice	SWS 3

Mo Phy	dule name /sics (EE)					
Mo 05-	dule nr. 91-1033	Credit points 6 CP	Workload 180 h	Self-study 105 h	Module duration 1 Term	Module cycle Every Semester
Lar Ger	iguage man			Module owner Prof. Dr. rer. nat.	Joachim Enders	
1	Teaching co Mechanics:	ontent Basics, force, momen	tum, work, energ	y, rigid-body mech	anics;	
	Fundamenta	als of thermodynamic	cs: Temperature, 1	st law, heat transp	oort;	
	Oscillations	and waves: mechani	cal and electrodyr	namic;		
	Optics: Geor	metrical optics, wave	and quantum opt	ics, laser;		
2	Fundamenta	als of quantum physic	cs: quanta, uncert	ainty relation, ato	mic structure	
	Students	Jeeuves				
	know selected fundamental concepts and experimental methods in classical and modern physics with respect to topics in mechanics, thermodynamics, electromagnetic fields and waves, optics, and the structure of matter, are capable of reconstructing analogies between these areas of physics, of understanding the funda-					
	are capable of reconstructing analogies between these areas of physics, of understanding the funda- mental process of physical reasoning,					
	are competent to apply their fundamental understanding of physics to specific problems by developing quantitative and qualitative solutions indepently,					
	are capable knowledge.	of understanding	technical applica	ations as well as	phenomena in nat	ure based on their
3	Recomment none	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	camination, Exam	ination, Duration:	120 Min., Default RS	3)
5	Prerequisite Passed exam	e for the award of c	redit points			
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. Elektro	the module Ditechnik und Informa	ationstechnik (ma	ndatory),		
	B.Sc. Mediz	intechnik (mandator	y),			
	B.Sc. Angew	vandte Mechanik (ma	andatory)			
8	Grade bonu	is compliant to §25	(2)			

9	References Hering, Martin,	Stohrer: Physik für Ingenieure (Springer)						
	Demtröder: Expe	erimentalphysik 1, Experimentalphysik 2, Experimentalphysik	3 (Springer)					
	Gerthsen: Physik	x (Springer)						
	Giancoli: Physics	: Principles with Applications (Pearson)						
	Halliday, Resnick, Walker: Fundamentals of Physics (Wiley)							
	Tipler, Mosca, Ph	sysics for Scientists and Engineers (W.H. Freeman)						
Co	urses							
	Course nr. 05-11-0223-vl	Course name Physik für ET						
	Instructor		Type Lecture	SWS 3				
	Course nr.Course name05-13-0223-uePhysik für ET							
	Instructor		Type Practice	SWS 2				
Mo Ger	dule name neral Compute	er Science I						
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Mo 20-	dule nr. 00-0304	Credit points 6 CP	Workload 180 h	Self-study 150 h	Module d	luration	Module cyc Summer ter	cle rm
Lar Ger	iguage man			Module owner Prof. Dr. rer. nat.	Karsten W	eihe		
1	Teaching co	ntent						
2	Learning ob	jectives						
	Basic Knowledge of Computer Science ConceptsPractical Work with computers							
	Fundamental Programming Skills							
3	Recommended prerequisites for participation							
4	Form of examination Course related exam:							
	• [20-00-0304-iv] (Technical examination, Oral/written examination, Default RS)							
5	Prerequisite for the award of credit points Pass exam (100%)							
6	Grading Course relate • [20-00	ed exam: -0304-iv] (Technica	l examination, Ora	al/written examina	ition, Weigh	nting: 100	%)	
7	Usability of	the module						
8	Grade bonu	s compliant to §25	(2)					
9	9 References David J. Barnes und Michael Kölling, Objects First with Java: A Practical Introduction using BlueJ, Fifth edition, Prentice Hall/Pearson Education, 2012, ISBN 978-013-249266-9							
Coi	ırses							
	Course nr. 20-00-0304-	iv General Comp	uter Science I					
	Instructor					Type Integrate	d course	SWS 2

Mo	dule name	ing (FF)						
Mo 04-	dule nr. 10-0603	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module of 1 Term	duration	Module cyc Summer ter	cle rm
Lar Ger	iguage man		I	Module owner Prof. Dr. rer. nat.	Stefan Ull	orich		
1	Teaching co	ntent		I				
2	Learning ob	jectives						
3	Recommended prerequisites for participation							
4	Form of examinationModule exam:Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)							
5	Prerequisite for the award of credit points Passing the final module examination							
6	Grading Module exam • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of	the module						
8	Grade bonus	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 04-10-0603-v	Course name7uScientific Com	puting					
	Instructor					Type Lecture a	nd practice	SWS 3

Mo Tec	dule name hnical Mecha	nics for Electrical En	gineering				
Mo	dule nr. 26-6400	Credit points	Workload	Self-study	Module duration	Module cycle	
Lan Ger	nguage man	0.01	100 11	Module owner Prof. DrIng. Chr	istian Mittelstedt	Summer term	
1	Teaching content Statics: force, moment (torque), free body diagram, equilibrium equations, center of gravity, truss, beams, adhesion and friction. Mechanics of elastic bodies: stress and deformation, tension, torsion, bending. Kinematics: point and rigid body movement. Kinetics: dynamic force and moment equilibrium equations, energy and work, linear oscillators, momentum and angular momentum conservation laws, impact.						
2	2 Learning objectives In this course the students will learn the basic concepts of technical mechanics. They should be able to analyze the statics of simple statically determinate planar systems, to carry out elementary elastomechanical calculations of statically determinate and statically indeterminate structures, to describe and analyze movements, and to solve planar motion problems, oscillation and shock phenomena with the laws of kinetics.						
3	Recommended prerequisites for participation						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 						
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation				
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of	the module					
8	Grade bonu	is compliant to §25	(2)				
9	References Markert, No Exercises ar	orrick: Einführung in e embodied in the bc	die Technische M ook.	echanik, ISBN 978	-3-8440-3228-4		
	Further read Markert: Sta Markert: Ela Markert: Dy Gross, Haug Hagedorn: 1	ling: atik - Aufgaben, Übur astomechanik - Aufga ynamik - Aufgaben, Ü ger, Schröder, Wall: To Fechnische Mechanik	ngs- und Prüfungs Iben, Übungs- und Ibungs- und Prüfu echnische Mechan I, Band 1 - 3. Verla	saufgaben mit Lösu l Prüfungsaufgaben ngsaufgaben mit L nik 1 - 3. Springer-V ag Harri Deutsch Fr	ngen, ISBN 978-3-84 1 mit Lösungen, ISBN ösungen, ISBN 978-3 Verlag Berlin (2012-2 rankfurt.	440-3279-6 1 978-3-8440-3280-2 3-8440-2200-1 2014).	
Coι	ırses						

Course nr. 16-26-6400-vl	Course name Technical Mechanics for Electrical Engineering		
Instructor		Type Lecture	SWS 3
Course nr. 16-26-6400-ue	Course name Technical Mechanics for Electrical Engineering		
Instructor		Type Practice	SWS 2

Мо	dule name					
Alg	orithms and l	Data Structures	I	1		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
20-	-00-0005 10 CP 300 h 180 h 1 Term Summer term					Summer term
German Prof. Dr. phil. nat. Marc Fischlin						
1	Teaching co	ontent				
	 data structures: array, list, binary search tree, B-tree, graph representation, hash table, heaps algorithms: sorting algorithms, string matching, graph traversal, insertion, search, and deletion for data structures, shortest path search, minimal spanning trees asymptotic complexity: run times, Big O notation, complexity classes P and NP, NP completeness algorithmic strategies. for example: Divide-and-Conquer, dynamic programming, brute-force, greedy, backtracking, meta heuristics 					
2	Learning of Upon succes the complex and to asses and can app	bjectives ssful completion of the ity classes P, NP, and ss and determine asyn oly them.	e module students NPC. They acquire nptotic complexity	get to know fundar e the abilities to app 7. Furthermore, the	nental data structures ply fundamental princ y understand major a	s and algorithms and ciples of algorithmics lgorithmic strategies
3	Recommended prerequisites for participation Recommended: Prior attendance of "Functional and Object-Oriented Programming Concepts" or a comparable course.					
4	Form of exa Course relat • [20-00 • [20-00 See german	amination ted exam: D-0005-iv] (Study ach D-0005-iv] (Technical description.	nievement, Oral/v examination, Ora	vritten examinatior al/written examina	n, p/np RS) tion, Default RS)	
5	Prerequisit Pass exam (e for the award of c 100%)	redit points			
6	Grading Course relat • [20-00 • [20-00	ted exam: D-0005-iv] (Study ach D-0005-iv] (Technical	nievement, Oral/v examination, Ora	vritten examinatior al/written examina	n, Weighting: 0 %) tion, Weighting: 100	%)
7	Usability of B. Sc. Inform B.Sc. Wirtso JBA Informa B.Sc. Inform B.Sc. Comp Lehramt an Bachelor/M	f the module matik chaftsinformatik atik nationssystemtechnik utational Engineering Gymnasien - Fach In aster of Education mi	g formatik it beruflicher Fach	richtung oder Unte	errichtsfach Informati	ik
	May be used	1 in other degree pro	grams.			
8	Grade bonu In dieser Ver Novelle der 14.07.2022	as compliant to §25 ranstaltung findet ein Allgemeinen Prüfung beschlossenen Anrec	(2) e Anrechnung von gsbestimmungen hnungsregeln zu e	vorlesungsbegleite der TU Darmstadt einer Notenverbess	enden Leistungen stat und den vom Fachbe erung um bis zu 1.0	t, die lt. 25(2) der 6. reich Informatik am führen kann.

9	References Will be appointed	l in lecture.			
Co	Courses				
	Course nr. 20-00-0005-iv	Course name Algorithms and data structures			
	Instructor		Type Integrated course	SWS 8	

Mo Ger	dule name	er Science II				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
20-	00-0290	6 CP	180 h	120 h	1 Term	Winter term
Language Module owner German Prof. Dr. rer. nat. Karsten Weihe						
1	Teaching co	ontent				
	In this cour	se, students learn fu	indamental algor	ithms and data str	ructures using advar	nced concepts of the
	programmin	ig language Java.				
	Recapitulati	on Basic Java:				
	* Variables, Types, Classes, Program Flow					
	* Arrays and	Collections	interfaces			
	Advanced Pr	rogramming Concept	S			
	* Graphical * Input/Out	put				
	* Error Hand	lling and Exceptions				
	Algorithms a * Recursion	and Data Structures				
	* Sorting alg	gorithms				
	* Stacks, Lis	ts, Queues,				
	* Trees and	Graphs				
2	Learning of	ojectives				
	After comple	etion of this course, s	tudents are able t	0		
	- use fundan	nental algorithms and	d data structures o	of computer science	e	
	- estimate ar	nd compare the quali	ty of elementary a	algorithms with res	pect to complexity a	nd run-time
3	Recomment	ded prerequisites fo	or participation			
	- elementary	programming skills	in Java			
	- basic know	ledge in computer sc	eience			
4	Form of eva	mination				
	Course relat	ed exam:				
	• [20-00)-0290-iv] (Technical	examination, Ora	al/written examina	tion, Default RS)	
5	Prerequisite	e for the award of c	redit points			
6	Grading	/ / / /				
	Course relat	ed exam:		1		
	• [20-00)-0290-iv] (Technical	examination, Ora	al/written examina	tion, Weighting: 100)%)
7	Usability of	the module				
8	Grade bonu	s compliant to §25	(2)			
9	References					

Java lernen mit BlueJ: Eine Einführung in die objektorientierte Programmierung David J. Barnes, Michael Kölling Pearson Studium 4., aktualisierte Auflage, 2009 ISBN-13: 978-3-8689-4001-5

Algorithmen in Java Robert Sedgewick Pearson Studium 3. überarbeitete Auflage, 2003 ISBN-13: 978-3-8273-7072-3

Einführung in die Programmierung mit Java Robert Sedgewick, Kevin Wayne Pearson Studium 1. Auflage, 2011 ISBN-13: 978-3-8689-4076-3

Courses

Course nr. 20-00-0290-iv	Course name General Computer Science II		
Instructor		Type Integrated course	SWS 4

Technical Thermodynamics I Module nr. Credit points Workload Self-study Module duration Module cycle 16-14-5010 6 CP 180 h 105 h 1 Term Winter term Language Module owner Prof. DrIng. Peter Stephan Workload 105 h 1 Term Winter term 1 Teaching content Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of en (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substar first law of thermodynamics and energy balances for technical systems; second law of thermodynamics entropy balances for technical systems; second law of thermodynamics; carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cp processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps. 2 Learning objectives On successful completion of this module, students should be able to: 1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system apply them within calculations of thermal system behaviour. 2. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define the 3. Analyse technical systems and processes using energy balance or an exergy analysis. 5. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change process 6. Apply this basic k	Mo	odule name						
Module nr. 16-14-5010 Credit points 6 CP Workload 180 h Self-study 105 h Module duration 1 Term Module cycle Winter term Language German Module owner Prof. DrIng. Peter Stephan Winter term 1 Teaching content Prof. DrIng. Peter Stephan Iterm of thermodynamics; thermodynamic equilibrium and temperature; different forms of en (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substar first law of thermodynamics and energy balances for technical systems; second law of thermodynamics entropy balances for technical systems; exergy analysis; thermodynamic behaviour during phase change; carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cp processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps. 2 Learning objectives On successful completion of this module, students should be able to: 1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system apply them within calculations of thermal system behaviour. 2. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define the 3. Analyse technical systems and processes using energy balances and equations of state. 4. Assess energy conversion processes by means of an entropy balance or an exergy analysis. 5. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change process 6. Apply this basic knowledge (15.) to examine machines (turbines, pumps etc.) and processes for energy conversion (combustion engine, power plants, refrigerators, heat pumps). 3 Recommended pr	Tec	chnical Thermo						
Id=14-3010 0 CP 180 ft 103 ft 1 Feffit Winter term Language Module owner Prof. DrIng. Peter Stephan 1 Teaching content Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of en (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substar first law of thermodynamics and energy balances for technical systems; second law of thermodynamics; entropy balances for technical systems; exergy analysis; thermodynamic behaviour during phase change; carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cp processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps. 2 Learning objectives On successful completion of this module, students should be able to: 1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system apply them within calculations of thermal system behaviour. 2. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define the 3. Analyse technical systems and processes using energy balances or an exergy analysis. 5. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change processes for enconversion (combustion engine, power plants, refrigerators, heat pumps). 3 Recommended prerequisites for participation 4 Form of examination Module exam: • Module exam (Technical examination, Examinat	Mo	odule nr.						
German Prof. DrIng. Peter Stephan 1 Teaching content Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of en (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substar first law of thermodynamics and energy balances for technical systems; second law of thermodynamics entropy balances for technical systems; exergy analysis; thermodynamic behaviour during phase change; carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cy processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps. 2 Learning objectives On successful completion of this module, students should be able to: 1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system apply them within calculations of thermal system behaviour. 2. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define the 3. Analyse technical systems and processes using energy balances or an exergy analysis. 5. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change process (a. Apply this basic knowledge (15.) to examine machines (turbines, pumps etc.) and processes for enconversion (combustion engine, power plants, refrigerators, heat pumps). 3 Recommended prerequisites for participation 4 Form of examination Module exam: • Module exam (Technical examination, Examination, Duration: 150 Min., Default RS)	10-14-5010 0 CP 180 II 105 II 1 fermi Winter termi Language Module owner							
 Teaching content Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of en (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substat first law of thermodynamics and energy balances for technical systems; second law of thermodynamics entropy balances for technical systems; exergy analysis; thermodynamic behaviour during phase change; carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cp processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps. Learning objectives On successful completion of this module, students should be able to: Explain the relationships between thermodynamic properties and the thermodynamic state of a system apply them within calculations of thermal system behaviour. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define the 3. Analyse technical systems and processes using energy balances and equations of state.	German Prof. DrIng. Peter Stephan							
 Learning objectives On successful completion of this module, students should be able to: Explain the relationships between thermodynamic properties and the thermodynamic state of a system apply them within calculations of thermal system behaviour. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define the 3. Analyse technical systems and processes using energy balances and equations of state. Assess energy conversion processes by means of an entropy balance or an exergy analysis. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change process: Apply this basic knowledge (15.) to examine machines (turbines, pumps etc.) and processes for enconversion (combustion engine, power plants, refrigerators, heat pumps). Recommended prerequisites for participation Module exam:	1	1 Teaching content Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of energy (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substances; first law of thermodynamics and energy balances for technical systems; second law of thermodynamics and entropy balances for technical systems; exergy analysis; thermodynamic behaviour during phase change; the carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cyclic processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps.						
 3 Recommended prerequisites for participation 4 Form of examination Module exam: Module exam: Module exam (Technical examination, Examination, Duration: 150 Min., Default RS) 5 Prerequisite for the award of gradit points 	2	 2 Learning objectives On successful completion of this module, students should be able to: 1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system and apply them within calculations of thermal system behaviour. 2. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define them. 3. Analyse technical systems and processes using energy balances and equations of state. 4. Assess energy conversion processes by means of an entropy balance or an exergy analysis. 5. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change processes. 6. Apply this basic knowledge (15.) to examine machines (turbines, pumps etc.) and processes for energy conversion engine, power plants, refrigerators, heat pumps). 						
 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 150 Min., Default RS) Prorequisite for the award of gradit points 	3	Recommended prerequisites for participation						
5 Draraquisite for the sward of gradit points	4	Form of exa Module exar • Module						
Passing the examination	5	Prerequisite Passing the e						
 6 Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %) 	6	Grading Module exar • Modul						
 7 Usability of the module Bachelor MB Pflicht Bachelor WI-MB Master ETiT MFT, Bachelor Mechatronik 	7	['] Usability of the module Bachelor MB Pflicht Bachelor WI-MB Master ETIT MFT, Bachelor Mechatronik						
8 Grade bonus compliant to §25 (2)	8	Grade bonu						
 9 References P. Stephan; K. Schaber; K. Stephan; F. Mayinger: Thermodynamik, Band 1: Einstoffsysteme, Springer Verl Further material (slides, collection of exercises, table of fomulas etc.) is available through the Moodle system TU Darmstadt. 	9	References P. Stephan; J Further mate TU Darmstae						

Course nr. 16-14-5010-vl	Course name Technical Thermodynamics I		
Instructor		Type Lecture	SWS 3
Course nr. 16-14-5010-gü	Course name Technical Thermodynamics I - Group Exercise		
Instructor		Type Group practice	SWS 1
Course nr. 16-14-5010-hü	Course name Technical Thermodynamics I		•
Instructor		Type Lecture hall practice	SWS 1

Мо	dule name					
Fun	ctional and C	bject-oriented Progr	amming Concepts	0.10 . 1		
Mo 20-	dule nr. 00-0004	Credit points	Workload 300 h	Self-study 180 h	Module duration 1 Term	Module cycle Winter term
Language GermanModule owner Prof. Dr. phil. nat. Marc Fischlin						
1	Teaching co Basic competence terms and profit of abstraction The main to Basic of Found Found Design Basic t Funda Recurs Simple Basics Docum	ontent etences in science-bas rinciples of computer on and modeling in the pics are: concepts of programm ations of functional p ations of object-orient and implementation type systems mental data structur sion e I/O of testing menting source code	sed, problem-orier science. Developr ne field of comput ning languages programming lang neted programming n of small softwar es and algorithms	nted development of nent of essential pr er science. uages languages e systems and their complex	of software systems. I ogramming skills. Un	Introduction to basic aderstanding the role
2	Learning ol After succes object-orien • system langua • perfor • docum	ojectives sfully completing th ted programming lar natically solve small age concepts; m quality assurance nent source code usin	e module, the stunguages and they programming taking basic (unit) og standard tools.	idents are familiar are able to perform sks using function tests;	with the foundation the following tasks: al and/or object-orio	ns of functional and ented programming
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Course relat • [20-00 • [20-00 See german	amination ed exam:)-0004-iv] (Study acl)-0004-iv] (Technical description.	nievement, Oral/v examination, Ora	vritten examinatior al/written examina	a, p/np RS) tion, Default RS)	
5	Prerequisite Pass exam (e for the award of c 100%)	redit points			
6	Grading Course relat • [20-00 • [20-00	ed exam:)-0004-iv] (Study acl)-0004-iv] (Technical	nievement, Oral/v examination, Ora	vritten examinatior al/written examina	n, Weighting: 0 %) tion, Weighting: 100	%)
7	Usability of	the module				

	B. Sc. Informatik B.Sc. Wirtschafts JBA Informatik B.Sc. Information B.Sc. Computation	informatik nssystemtechnik nal Engineering				
	Lehramt an Gymnasien - Fach Informatik Bachelor/Master of Education mit beruflicher Fachrichtung oder Unterrichtsfach Informatik					
	May be used in other degree programs.					
8	Grade bonus con In dieser Veransta Novelle der Allge 14.07.2022 besch	npliant to §25 (2) Iltung findet eine Anrechnung von vorlesungsbegleitenden Leis meinen Prüfungsbestimmungen der TU Darmstadt und den v Ilossenen Anrechnungsregeln zu einer Notenverbesserung um	tungen statt, die lt. 25(2 om Fachbereich Informa bis zu 1.0 führen kann.	2) der 6. atik am		
9	References Will be announce	d in the course.				
Cot	urses					
	Course nr. 20-00-0004-iv	Course name Functional and Object-oriented Programming Concepts				
	Instructor		Type Integrated course	SWS 8		

Mo Par	dule name allel programi	ning						
Mo 20-	dule nr. 00-1152	Credit points 5 CP	Workload 150 h	Self-study 105 h	Module of 1 Term	luration	Module cyc Every 2. Se	cle emester
LanguageModule ownerGermanImage: Constraint of the second seco								
1	 Feaching content foundations of parallel systems parallel architectures programming models for parallel computing parallel algorithms significant practical programming exercises covering the above topics if necessary introduction to base programming languages 							
2	2 Learning objectives After successfully attending this course, students understand the foundations of parallel systems and can apply techniques for their correct as well as efficient programming. They can develop and analyze basic applications using parallel programming techniques on selected platforms.							
3	Recommend	led prerequisites fo	or participation					
4	 Form of examination Course related exam: [20-00-1152-iv] (Study achievement, Special form, Default RS) The form of the examination will be announced at the beginning of the course. One or a combination of a maximum of two of the following forms is possible. Software development (optional: including submission of source code and testata), written exam (duration 60 or 90 or 120 minutes), oral exam (duration 15 or 30 minutes), homework (optional: including testata), colloquium (optional: including presentation) portfolio 							
5	Prerequisite Pass Exam (2	for the award of c .00%).	redit points					
6	Grading Course relate • [20-00	ed exam: -1152-iv] (Study ac	hievement, Specia	l form, Weighting:	100 %)			
7	 ⁷ Usability of the module B.Sc. Computer Science Teacher training at high schools - subject computer science May be used in other degree program. 							
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 20-00-1152-	Course namewParallel programe	amming					
	Instructor					Type Integrate	d course	SWS 3

Mo	dule name					
Op	erating System	ms				
Mo 20-	dule nr. 00-0903	Credit points	Workload 150 h	Self-study 105 h	Module duration	Module cycle Winter term
Lar	iguage		100 11	Module owner		
Ger	man			Prof. Dr. phil. nat. Marc Fischlin		
1	 Teaching content Introduction to Operating Systems (OS) - Role, purpose and design issues Processes and Threads - OS structures, process control, abstractions, kernel/user modes and operations, context switching, interrupts Inter-Process Communication - Message passing IPC, RPC, layers, interfaces, hierarchies Coordination: Deadlocks - Process coordination, critical sections, deadlock characterization, deadlock detection and recovery, deadlock avoidance Scheduling/Resource Management - Task ordering, preemptive and non-preemptive scheduling, schedulers and policies, OS implementations Concurrency: Races, Mutual Exclusions - Critical sections, races, spin locks, synchronization Programming Abstractions: Semaphores - Semaphores, Monitors Memory Management - Storage structures, management/replacements approaches, virtual memory, paging caching, segmentation I/O - Device management, drivers, segmentation, interrupt handling, DMA File systems - File systems requirements, design and implementation, file structures, directories, naming partitions, virtual file systems Fault Tolerance/Resilience - Fault types, fault handling approaches, reliable message delivery, OS reliability and availability, security issues Embedded/RT OS - Memory/disk/performance management, recovery, fault-tolerances, real-time aspects Distributed OS - Distributed computation and communication abstractions, synchronization, coordination consistency Virtual Maching, Durpoes and turnes of virtualization virtual file avatame. Humanrison 					
2	Learning of Students w course atter requiremen creation of o	bjectives ill gain an overview ndance. Students are ts such as fault tolera operating systems.	on fundamental able to discuss aj nce, security and	Operating System oproaches to differ performance. More	concepts consequer ent concepts regardi eover, students acqui	nt to their succesful ing various technical re techniques for the
3	Recomment Recomment "Algorithme	ded prerequisites fo led: n und Datenstrukturer	or participation n", "Funktionale ur	nd objektorientierte	Programmierung", "I	Rechnerorganisation"
4	Form of examination Course related exam: • [20-00-0903-iv] (Technical examination, Oral/written examination, Default RS)					
5	Prerequisite for the award of credit points Pass exam (100%) Choosing this modul prohibits choosing Modul 20-00-0175 Operating Systems.					
6	Grading Course relat • [20-00	ted exam: 0-0903-iv] (Technical	examination, Ora	l/written examina	tion, Weighting: 100	%)
7	Usability of	f the module				

	B.Sc. Informatik B.Sc. Information May be used in c	nssystemtechnik ther degree programs.			
8	Grade bonus compliant to §25 (2)				
9	References - Modern Operating Systems; A. Tanenbaum, Prentice Hall, ISBN 0-13-813459-6 - Operating System Concepts; Silberschatz et al, John Wiley and Sons, ISBN 0-470-23399-3				
Co	urses				
	Course nr. 20-00-0903-iv	Course name Operating Systems			
	Instructor Prof. DrIng. And	dreas Koch	Type Integrated course	SWS 3	

Mo	dule name	hanics I (Statics)						
<u>Еп</u> е Мо	dule nr. 64-5190	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
Lar Ger	nguage man	0.01	100 H	Module owner Prof. DrIng. Martin Oberlack				
1	Teaching co Definition of supports, sta friction.	ntent f force, general syste atically determined s	ems of forces and system, trusses, be	equilibrium of rigi eams, frames, curv	d bodies, red beams	center of r , work prir	nass, reaction nciples, stabil	n of the ity and
2	 2 Learning objectives On successful completion of this module, students should be able to: 1. Discern and explain the concept of force, moment, and equilibrium. 2. Analyse statically determinate problems independently, i.e. to identify the forces, and determine their attack points and effects, and formulate equilibrium conditions. 3. Ascertain the support reactions in statically determinate systems by means of equilibrium conditions or the principle of virtual work. 4. Compute internal forces and moments in beams and trusses. 5. Determine the center of gravity of a given rigid body. 6. Determine the equilibrium positions of a given movable system and investigate their stability. 7. Analyse static systems including static or kinetic frictions and calculate corresponding forces. 							
3	Recommend None	led prerequisites fo	or participation					
4	Form of exa Module exar • Modul Written exar	mination n: e exam (Technical ex n 90 min	xamination, Exam	ination, Duration:	90 Min., D	9 (Default RS		
5	Prerequisite Passing the e	e for the award of c examination	redit points					
6	Grading Module exar • Modul	n: e exam (Technical ez	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of Bachelor ME Bachelor WI Bachelor Me	the module 9 Pflicht -MB chatronik, Computa	tional Engineering	g, BEd. Metalltechr	nik			
8	Grade bonu	s compliant to §25	(2)					
9	References Gross, Haug	er, Schröder, Wall: T	echnische Mechan	iik I: Statik, 4. Aufl	age 2009,	Springer \	/erlag.	
Cot	ırses	1						
	Course nr. 16-64-5190-	vl Engineering M	lechanics I (Static	s)				
	Instructor					Type Lecture		SWS 3

Course nr. 16-64-5190-gü	Course name Engineering Mechanics I (Statics) - Group Exercise		
Instructor		Type Group practice	SWS 2
Course nr. 16-64-5190-hü	Course name Engineering Mechanics I (Statics)		
Instructor		Type Lecture hall practice	SWS 1

Mo Eng	dule name ineering Mec	hanics II (Elastostati	cs)			
Mo	dule nr. 61-3011	Credit points	Workload	Self-study	Module duration	Module cycle
Lan Ger	nguage man	0.01	100 11	Module owner Prof. DrIng. Christian Mittelstedt		
1	Teaching co Stresses in 2 beams, defle	ontent 2D and 3D representa ection curve, shear in	tion, deformation fluence, torsion, ε	and strain rate, Ho energy principles in	oke's law, strength hy elastostatics, stabilit	potheses, bending of ty and buckling.
2	Learning of On successfi 1. Analyse s 2. Describe the correspo 3. Describe 4. Apply Eul determinati transversal f 5. Analyse t walled open 6. Apply th undeterminati 7. Analyse s	bjectives ul completion of this tatically determined one-, two- and three- onding prinicipal stre arbitrary strain states ler-Bernoulli's beam t on of the resulting be forces. corsion shafts, in part a cross-sections. he theorem of work ed systems. imple stability proble	module, students and statically und -dimensional stres sses. s in a correct man heory and Timosh ending and shear cicular for a circul balance and the ems and to apply 1	should be able to: etermined systems s states in a mathe ner and to apply th enko's beam theory deformation and th ar cross-section, th principle of virtua Euler's buckling cas	of bars. ematically correct mane the linear elasticity law in a correct manner the resulting distribut nin-walled closed cro al forces, in particula tes.	unner and to identify w. , in particular for the tion of moments and oss-sections and thin- ar also for statically
3	Recommen Engineering	ded prerequisites for Mechanics I (Statics	or participation) recommended			
4	Form of exa Module exa • Modul Written exa	amination m: le exam (Technical ex m 90 min	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisit Passing the	e for the award of c examination	redit points			
6	Grading Module exame • Module	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of Bachelor MI Bachelor WI Bachelor Me BEd. Metall	E the module B Pflicht I-MB echatronik, Computa technik	tional Engineering	5 52		
8	Grade bonu	is compliant to §25	(2)			
9 Coi	References Gross; Haug Gross; Ehler	ger; Schnell; Schröde rs; Wriggers: Formeln	r: Technische Meo 1 und Aufgaben zu	chanik 2, Elastostat ır Technischen Mec	ik, Springer Verlag. hanik 2, Springer Ve	rlag.

Course nr. 16-61-5010-vl	Course name Engineering Mechanics II (Elastostatics)		
Instructor		Type Lecture	SWS 3
Course nr. 16-61-5010-gü	Course name Engineering Mechanics II (Elastostatics) - Group Exercise		
Instructor		Type Group practice	SWS 2
Course nr. 16-61-5010-hü	Course name Engineering Mechanics II (Elastostatics)		•
Instructor		Type Lecture hall practice	SWS 1

Mo	dule name	hanics III (Dynam	ics)				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
Lan	iguage	000	1 100 11	Module owner Prof. DrIng. Ber	nhard Schweizer	whiter term	
1	Teaching co Kinematics o impact, prin	ontent of points and rigid ciples of mechanic	bodies, relative kind s (d'Alembert's prin	ematics, kinetics of ciple, Lagrange's ec	rigid bodies, work an quations).	nd energy, vib	orations,
2	 Learning objectives On successful completion of this module, students should be able to: Describe planar and spatial motions of point masses and rigid bodies. Analyse dynamical problems and derive the equations of motion for simple mechanical systems. Apply Newton's and Euler's laws in order to solve dynamical problems. Model simple vibration systems and solve simple differential equations. Apply the principles of mechanics. 						
3	Recomment Mathematics	ded prerequisites s I, Engineering M	for participation echanics I (Statics)	recommended			
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 						
5	Prerequisite for the award of credit points Passing the examination						
6	Grading Module exa • Modul	n: e exam (Technica	examination, Exam	ination, Weighting	: 100 %)		
7	Usability of Bachelor ME Bachelor WI Bachelor Me	the module 3 Pflicht -MB echatronik					
8	Grade bonu	s compliant to §	25 (2)				
9	ReferencesMarkert, R.: Technische Mechanik, Teil B (Dynamik), 2. Auflage, 2009.Hagedorn, P.: Technische Mechanik, Band 3: Dynamik, 3. Auflage, Verlag Harri Deutsch, Frankfurt 2006.Hibbeler, R. C.: Engineering Mechanics: Dynamics, 3rd Edition, Prentice Hall, 2004.						
Coι	irses	Course and					
	16-25-5120-	vl Engineering	ne 5 Mechanics III (Dyn	amics)			
	Instructor				Type Lecture		SWS 3
	Course nr. 16-25-5120-	gü Engineering	ne 3 Mechanics III (Dyn	amics) - Group Exe	ercise		1
	Instructor				Type Group pr	actice	SWS 2

Course nr. 16-25-5120-hü	Course name Engineering Mechanics III (Dynamics)		
Instructor		Type Lecture hall practice	SWS 1

Mo	dule name	mechanical compo	nents and actuato	rs for mechatronics	5			
Mo 16-	dule nr. 24-6410	Credit points 6 CP	Workload 180 h	Self-study 105 h	Module d	uration	Module cyc Winter tern	cle
Lar Ger	iguage man			Module owner Prof. DrIng. Stephan Rinderknecht				
1	Teaching co Mechatronic tools; mecha	ntent systems and compo nical components, a	nents; modelling; ctuators; synthesi	static and dynamic s of mechatronic sy	behaviour; /stems.	simulatio	n and corresp	onding
2	 2 Learning objectives On successful completion of this module, students should be able to: 1. Model Mechatronic Systems and their components and to present them by equations and Blockdiagrams. 2. Find results for the static and dynamic behaviour of mechatronic systems with MATLAB and to interpret these results. 3. Describe the mechatronic subsystem process and actuators and explain their function. 4. Evaluate the behaviour of the mechatronic components with focus on mechanical components and actuators that they are prepared for the synthesis of mechatronic systems. 							
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) Written exam 90 min 							
5	Prerequisite Passing the e	for the award of c	redit points					
6	Grading Module exan • Module	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of Bachelor Me	the module chatronik						
8	Grade bonu	s compliant to §25	(2)					
9	References Lectures not	es						
Co	ırses							
	Course nr. 16-24-6410-	vl Course name System model	ing, mechanical co	omponents and act	uators for n	nechatron	ics	
	Instructor					Type Lecture		SWS 3
	Course nr. 16-24-6410-	gü System model	ing, mechanical co	omponents and act	uators for n	nechatron	ics	1
	Instructor					Type Group pr	actice	SWS 1

Course nr. 16-24-6410-hü	Course name System modeling, mechanical components and actuators for	mechatronics	
Instructor		Type Lecture hall practice	SWS 1

2.1 Lectures

Mo Sys	dule name tem Dynamics	s and Automatic Con	trol Systems III					
Mo 18-	dule nr. ad-2010	Credit points 4 CP	Workload 120 h	Self-studyModule durationModule cycleh75 h1 TermWinter term				
Lar Ger	iguage man			Module owner Prof. DrIng. Jürg	gen Adamy			
1	Teaching co Topics cover	ed are:						
	 basic properties of non-linear systems, limit cycles and stability criteria, non-linear control of linear systems, non-linear control of non-linear systems, observer design for non-linear systems 							
2	Learning objectives After attending the module, a student is capable of:							
	 After attending the module, a student is capable of: explaining the fundamental differences between linear and non-linear systems, testing non-linear systems for limit cycles, stating different definitions of stability and testing the stability of equilibria, recalling the pros and cons of non-linear controllers for linear systems, recalling and applying different techniques for controller design for non-linear systems, designing observers for non-linear systems 							
3	Recommend	led prerequisites fo	r participation					
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	amination, Exam	ination, Duration:	180 Min., Default RS	i)		
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Technical ex	amination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	CE, M.Sc. etit - A	UT, M.Sc. MedTec,	, B.Sc. und M.Sc. iST	, M.Sc. etit - VAS		

8	Grade bonus co	Grade bonus compliant to §25 (2)				
9	References Adamy: Systemd	ynamik und Regelungstechnik III (available for purchase at tl	ne FG office)			
Co	urses					
	Course nr. 18-ad-2010-vl	Course nr.Course name18-ad-2010-vlSystem Dynamics and Automatic Control Systems III				
	Instructor Prof. DrIng. Jür	gen Adamy, DiplIng. Markus Kramer	Type Lecture	SWS 2		
	Course nr.Course name18-ad-2010-ueSystem Dynamics and Automatic Control Systems III					
	Instructor Prof. DrIng. Jür	gen Adamy, DiplIng. Markus Kramer	Type Practice	SWS 1		

Mo Fuz	dule name zy Logic, Neu	ral Networks and Ev	olutionary Algorit	hms			
Mo	dule nr.	Credit points	Workload	Self-study	Module durat	ion Module cy	cle
Lan	nguage man	Cr	120 11	Module owner Prof. DrIng. Jürg	gen Adamy	Winter terr	11
1	1 Teaching content Fuzzy systems: basics, rule based fuzzy logic, design methods, decision making, fuzzy control, pattern recognition, diagnosis; Neural networks: basics, multilayer perceptrons, radial basis functions, pattern recognition, identification, control, interpolation and approximation, Neuro-fuzzy: optimization of fuzzy systems, data driven rule generation; Evolutionary algorithms: optimization problems, evolutionary strategies and their applications, genetic programming and its applications.						n recog- gnition, a driven ications,
2	 2 Learning objectives After attending the module, a student is capable of: recalling the elements and set-up of standardized fuzzy-logic, neural networks and evolutionary algorithms, discussing the pros and cons of certain set- ups of systems from computational intelligence for solving a given problem, recognizing situations in which tools taken from computational intelligence can be applied for problem solving, creating programs from algorithms taught in the lecture, and extending the learned standard procedures in order to solve new problems. 						
3	Recommend	led prerequisites fo	or participation				
4	Form of exa Module exar • Module	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Defaul	RS)	
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting:	: 100 %)		
7	Usability of B.Sc. MEC, I B.Sc. und M	the module M.Sc. MEC, M.Sc. et Sc. iST, B.Sc. WI-eti	it - SAE, M.Sc. W it, M.Sc. etit - VAS	I-etit, M.Sc. CE, M	.Sc. etit - AUT,	M.Sc. MedTec, B.	Ed. etit,
8	Grade bonu	s compliant to §25	(2)				
9	References Adamy: Fuzz the FG office	zy Logik, Neuronale)	Netze und Evoluti	onäre Algorithmen	, Shaker Verlag	(available for pure	chase at
Co ι	irses						
	Course nr. 18-ad-2020-	vl Fuzzy Logic, N	Jeuronal Networks	and Evolutionary	Algorithms		
	Instructor Prof. DrIng.	Jürgen Adamy			Typ Lect	e ure	SWS 2

Course nr. 18-ad-2020-ue	Course name Fuzzy Logic, Neuronal Networks and Evolutionary Algorithm	S	
Instructor Prof. DrIng. Jür	gen Adamy, DiplIng. Kalina Olhofer-Karova	Type Practice	SWS 1

Mo Evo	dule name lutionary Sys	tems - From Biology	to Technology					
Mo 18-	dule nr. ad-2050	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module of 1 Term	duration	Module cyc Summer ter	c le rm
Lan Ger	iguage man	I	I	Module owner Prof. DrIng. Jür	gen Adamy	y		
1	Teaching content theory of biological evolution, introduction to genetics, population genetics, population growth, evolutionary algorithms, applications, DNA computing, artificial life, theory of evolutionary algorithms, optimization algo- rithms, multi-objective optimization, meta models, co-evolution, genetic coding, representations of evolutionary algorithms, developmental processes, self-adaptation							
2	 Learning objectives After attending the module, a student is capable of: understanding the basic principles of evolutionary biology on a systems level, transferring of this knowledge to the technical domain (evolutionary algorithms), applying evolutionary algorithms to hard optimization problems, gaining insight into the potentials and challenges of interdisciplinary research (natural and engineer- ing/computer science). 							
3	Recommended prerequisites for participation Introductory courses mathematics. Basic computer skills.							
4	Form of exa Module exa • Modul	amination m: e exam (Technical e:	xamination, Oral e	examination, Durat	ion: 30 Mi	n., Defaul	t RS)	
5	Prerequisite Passing the	e for the award of c final module examination	redit points ation					
6	Grading Module exa • Modul	m: e exam (Technical e:	xamination, Oral e	examination, Weigh	nting: 100	%)		
7	Usability of B.Sc. MEC, 1	² the module M.Sc. MEC, M.Sc. W	I-etit, M.Sc. CE, B	S.Sc. und M.Sc. iST	1			
8	Grade bonu	is compliant to §25	(2)					
9	 References D.J. Futuyama: Evolutionary Biology. W. Henning, Genetik, Springer Verlag D.B. Fogel: Evolutionary Computation, IEEE Press I. Rechenberg: Evolutionsstrategie '94 HP. Schwefel: Evolution and Optimum Seeking 							
Coι	irses	Courses						
	18-ad-2050-	vl Evolutionary S	Systems - From Bio	ology to Technology	/			1
	Instructor Prof. Dr. rer.	nat. Bernhard Send	hoff			Type Lecture		SWS 2

Mo	dule name	in Engineering				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	18-ad-2090 3 CP 90 h			60 h	1 Term	Winter term
Lar Ger	iguage man			Module owner Prof. DrIng. Jür	gen Adamy	
1	 leaching content A Basics Scene Representation 2D and 3D Geomtery Image Acquisition Geometric Projections Camera Calibration Objective and Illumination Discrete 2D signals Separability, Sampling Transformation, Interpolation Convolution, Correlation Discrete Fourier Transformation B Basics of Image Analysis Filtering Basics2D Filter Design Linear Filtering Nichtlinear Filtering Image Decompositions Multi-scale Representation Pyramids Filter Banks Image Features Structure Moments, Histograms 					
2	Learning of After success the field of e range from a driver assista The students two-dimensi to infer know problems that	ojectives iful completion, the mengineering. The focu- visual quality inspectance etc. is should obtain a goo ional projection onto vledge from the world at arise in computer	nodule teaches man s is on methods th tion, visual roboti d understanding f the image plane o d given image data vision and how to	thematical basics ne tat are relevant for cs, photogrammet for the relations bet of a camera. They a a. They should deve choose an efficien	eeded to solve comput measuring and contro- ry, visual odometry u ween the three-dime ilso should learn abou elop some feeling for t solution in terms of	ter vision problems in ol tasks. Applications up to visually guided nsional world and its ut methods that exist the different kinds of algorithms.
3	Recommen	ded prerequisites fo	or participation			
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 10 students register, the examination will be an oral examination (duration: 30 min.). The type of examination will be announced in the beginning of the lecture. 					
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	Grading					

	Module exam:					
	• Module exam (Technical examination, Oral/written examination, Weighting: 100 %)					
7	Usability of the	module				
	M.Sc. MEC, M.Sc	. WI-etit, M.Sc. CE, M.Sc. etit - AUT, M.Sc. MedTec, M.Sc. iCh	E, B.Sc. und M.Sc. iST			
8	Grade bonus con	npliant to §25 (2)				
9	References	books. Losturo slides, exercise shoets and mother and				
	Further reading	books: Lecture sindes, exercise sneets and manab-code.				
	Further reading					
	1. Yi Ma, Stefa	ano Soatto, Jana Kosecka und Shankar S. Sastry, An Invitation	to 3-D Vision - From Im	ages to		
	Geometric	Models, Springer, 2003.		-		
	2. Richard Ha	rtley and Andrew Zisserman, Multiple View Geometry in Con	mputer Vision, Second I	Edition,		
	3. Karl Kraus.	Photogrammetrie, Band 1 Geometrische Informationen aus Ph	notographien und Lasers	canner-		
	aufnahmen	7. Auflage, de Gruyter Lehrbuch, 2004.				
	4. Christopher	M. Bishop, Pattern Recognition and Machine Learning, Sprin	ger 2006.			
	5. Bernd Jähn	e, Digital Image Processing, 6. Auflage, 2005.				
Co	urses					
	Course nr.	Course name				
	18-ad-2090-vl	Computer Vision in Engineering	1			
	Instructor		Туре	SWS		
	DrIng. Thomas	Guthier, M.Sc. Frank Ziegler	Lecture	2		

Mo Ma	dule name chine Learnir	ng and Deep Learning	g for Automation S	Systems		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18- Lar	ad-2100	3 CP	90 h	60 n Module owner	1 Ierm	Summer term
Ger	man			Prof. DrIng. Jür	gen Adamy	
1	Teaching co	ontent				
	 Concepts of machine learning Linear methods Support vector machines Trees and ensembles Training and assessment Unsupervised learning Neural networks and deep learning Convolutional neuronal networks (CNNs) CNN applications Recurrent neural networks (RNNs) 					
2	 Learning objectives Upon completion of the module, students will have a broad and practical view on the field of machine learning. First, the most relevant algorithm classes of supervised and unsupervised learning are discussed. After that, the course addresses deep neural networks, which enable many of today's applications in image and signal processing. The fundamental characteristics of all algorithms are compiled and demonstrated by programming examples. Students will be able to assess the methods and apply them to practical tasks. 					
	Fundamenta Preferred: L	al knowledge in linea ecture "Fuzzy logic, t	r algebra and stat neural networks a	istics nd evolutionary alg	gorithms"	
4	Form of exa Module exa • Modul The examina 7 students r will be anno	amination m: le exam (Technical ex ation takes place in fo register, the examinat ounced in the beginni	xamination, Oral/ orm of a written ex ion will be an ora ing of the lecture.	written examinatio am (duration: 90 n l examination (dur	n, Duration: 90 Min. ninutes). If one can es ation: 30 min.). The	, Default RS) stimate that less than type of examination
5	Prerequisit Passing the	e for the award of c final module examination	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 					
7	Usability of B.Sc. etit, B	f the module .Sc. MEC, M.Sc. MEC	, M.Sc. WI-etit, M	.Sc. CE, M.Sc. etit -	AUT, M.Sc. MedTec,	B.Sc. und M.Sc. iST
8	Grade bonu	is compliant to §25	(2)			
9	References					

- T. Hastie et al.: The Elements of Statistical Learning. 2. Aufl., Springer, 2008
- I. Goodfellow et al.: Deep Learning. MIT Press, 2016
- A. Géron: Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow. 2. Aufl., O'Reilly, 2019

Courses

Course nr. 18-ad-2100-vl	Course name Machine Learning and Deep Learning for Automation System	15	
Instructor DrIng. Michael	Vogt	Type Lecture	SWS 2

Mo	dule name							
Aut	Automated Driving							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18- Lar		3 CP	90 h	00 n Module owner	1 Ierm	winter term		
Eng	English Prof. DrIng. Jürgen Adamy							
1	Teaching co	ontent						
	 History of Automated Driving Terminology and Paths towards Automated Driving Architectures, Building Blocks, and Components Perception & Environment Models Data Fusion & State Estimation Deep Dive: Target Tracking & Traffic Participant Fusion Deep Dive: Grid Fusion & Free Space Estimation Deep Dive: Road Model Fusion Localization, Digital Maps, and Vehicle-To-X Communication Situation Understanding, Prediction, and Criticality Assessment Deep Dive: Probabilistic Driving Maneuver Detection Behavior & Trajectory Planning, Decision Making Automated Driving Software Development & Test Open Challenges & State-of-the-Art Research Topics 							
2	 2 Learning objectives Upon successful completion of the module, students will be able to: is familiar with the history and terminology of automated driving systems, knows important architectures, building blocks, and components of automated vehicles, understands different perception, environment model, and data fusion approaches, has an idea about relevant methods (e.g. Bayesian Inference & Probabilistic Graphical Models, State Estimation, Deep Learning, Dempster-Shafer Theory) and knows how they can be beneficially applied in different of automated driving areas (e.g. detection, target tracking & traffic participant fusion, grid fusion, road model fusion, localization), is familiar with the challenges of situation understanding, prediction, and criticality assessment and knows exemplary methods to tackle the problem, is aware of exemplary behavior & trajectory planning approaches, knows best practices about automated driving software development & test (e.g. continuous integration, verification & validation, test-driven development, key performance indicators), and is familiar with open challenges and research topics. 							
3	3 Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 							
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading							

	Module exam: • Module exa	m (Technical examination, Examination, Weighting: 100 %)		
7	Usability of the M.Sc. MEC, M.Sc	module WI-etit, M.Sc. etit - AUT, M.Sc. iCE, B.Sc. und M.Sc. iST		
8	Grade bonus co	npliant to §25 (2)		
9	References Own lecture slide following books of Eskandaria Siciliano, B Thrun, S.; I MIT Press, Watzenig, D 2017. Winner, H. Active Safe	es are distributed in advance of any lecture. For more detailed can be recommended: n, A.: Handbook of Intelligent Vehicles. Springer, London, 201 .; Khatib, O.: Springer Handbook of Robotics. 2nd Edition, Spr Burgard, W.; Fox, D.: Probabilistic Robotics. Intelligent Robotic Cambridge, 2006. .; Horn, M.: Automated Driving. Safer and More Efficient Future et al.: Handbook of Driver Assistance Systems. Basic Informatio ty and Comfort. Springer, Switzerland, 2016.	insights into the topic a 2. ringer, Berlin Heidelberg s and Autonomous Ager e Driving. Springer, Switz n, Components and Syst	rea, the g 2016. uts. The zerland, ems for
Co	urses			
	Course nr. 18-ad-2110-vl	Course name Automated Driving		
	Instructor DrIng. Matthias	Schreier	Type Lecture	SWS 2

Mo Me	dule name dical Device R	egulation					
Mo 18-	dule nr. ad-2120	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cycle Winter term	
Lan Ger	i guage man	1	I	Module owner Prof. DrIng. Jür	gen Adamy	1	
1	1 Teaching content • Introduction • Quality management system according to ISO 13485 • Processes according to the quality management system • Verification and Validation • Requirements of the MDR • Classification and placing medical products on the market • Risk Management • Clinical evaluation and investigation • Post-market surveillance • The system of notified bodies • Audits						
2	Learning of Students red students are medical dev	ojectives ceive a broad and pr able to work accord ices.	ractical overview ing to legal and re	of medical device egulatory requirem	regulation. After attents and to contribute	tending this module te to the approval of	
3	Recommen	ded prerequisites fo	or participation				
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)		
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Technical ex	amination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. MedT	the module ec					
8	Grade bonu	s compliant to §25	(2)				
9	References						
	 2017/745/EU Medical Device Regulation ISO 13485: 2016 - Medical devices - Quality management systems - Requirement for Stand: 12.03.2020 Seite 2 regulatory purposes 						
Coι	ırses						

Course nr. 18-ad-2120-vl	Course name Medical Device Regulation					
Instructor DrIng. Andreas	Röse, Dr.rer.nat Olaf Kessel-Deynet	Type Lecture	SWS 2			
Module nr. 18-ad-2130	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Summer term	
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Language English	1	I	Module owner Prof. DrIng. Jürgen Adamy			
 Teaching co Part I: Class useful necess uncon conver Karusl optim proper optimi iteratii Part II: Opt conser distribi gradie constr weight state of challer Part III: Op genera Nash of discretion variation variation exister gradie contin 	sical theory of uncor facts from analysis (ary and sufficient con- strained optimization, to optimization, its con- r-Kuhn-Tucker conditi- ization subjected to in- ve procedure imization in multi- ansus in multi-agent sy unication protocols: a sus algorithm and it uted optimization pr nt-based procedure v ained distributed op t-balanced communic of the art (convergence anges) timization in multi- al game formulation, equilibrium concept te action games, exist uous action games (co- onal inequalities, gam ace and uniqueness of nt methods in conver- onvergence in the cas agence) of the art (convergence -based methods, mod	nstrained and co differentiable fund nditions of extrem a problem: existen nvergence and con- tion convex simple co equality constrain gent systems: Di ystems, motivating gossip, weight-bal s convergence (wi oblems in multi-a, with weight-baland otimization (motive cation and its conve- ce rate discussion, agent systems: Co examples tence of a mixed-se continuous action and of Nash equilibrium x games (converge- e of games with p ace rate discussion lern applications a	nstrained optimiz ctions, gradients, H um ce, uniqueness, and nvergence rate nstraints, gradient ts, primal-dual app istributed (cooper g examples anced communication ath the proof for we gent systems, motificed communication vating examples, p vergence, discussion unbalanced comm Game-theoretic (not extrategy Nash equiling games with convex their connection to n in convex games ence in the case of g urely monotone ma h, information settiand their challenge	Eation: Iessian matrices, conv d stability of solution roach, Lagrangian, Ar rative) optimization tion eight-balanced comm vating examples n and its convergence orojected gradient-ba n on the primal-dual punication, modern ap con-cooperative) opti ibrium cost functions, exam Nash equilibria proble games with strongly pa appings, regularized ings in the system: cost s)	vex functions) , gradient descent i and its convergence row-Hurwicz-Uzaw unication) sed procedure wit approach) oplications and the mization uples) ems in convex game monotone mapping algorithms and the ommunication- an	

	Firsty, students refresh the knowledge on the classical results in convex optimization. Next, students deal with two main types of optimization problems in multi-agent systems: cooperative and non-cooperative optimization. Some practical examples are demonstrated. Students learn how to solve cooperative optimization problems by mean of consensus-type communication-based algorithms in the networked multi-agent systems. Moreover, they get insights in the modern applications and current challenges of cooperative optimization. In the case when each agent in a multi-agent system follows the goal to optimize its own objective a so-called non- cooperative game-theoretic optimization problem is formulated in the system. Students are able to formulate this problem, namely to define a game with its main component and solution concepts (action sets, individual cost funtions, Nash equilibria). Further the focus is on continuous action convex games. To find a solution (a Nash equilibrium in a given game), students use the connection between Nash equilibria in games and solutions of the corresponding variational inequalities. Furthemore, students are able to investigate the properties of the game (strongly/strictly monotone, merely monotone game) to apply an appropriate optimization procedure (gradient-based or regularized one) to achieve a solution. Finally, students get insights in different settings of information in the game-theoretic optimization (where only partial information is available to each agent) and know approaches that can be applied in each case.					
3	Recommended Mathematics I, II	prerequisites for participation , III				
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 					
5	Prerequisite for the award of credit points Passing the final module examination					
6	 Grading Module exam: Module exam (Technical examination, Oral examination, Weighting: 100 %) 					
7	Usability of the M.Sc. WI-etit. M	module Sc. etit - AUT. B.Sc. und M.Sc. iST				
8	Grade bonus co	mpliant to §25 (2)				
9	References 1. Nedic and A. Ozdaglar "Cooperative Distributed Multi-Agent Optimization" in the book "Convex Optimization in Signal Processing and Communications" by Y. Eldar and D. Palomar 2. F. Facchinei JS. Pang "Finite-Dimensional Variational Inequalities and Complementarity Problems"					
Co	urses					
	Course nr. 18-ad-2130-vl	Course name Optimization in Multi-Agent Systems				
	Instructor Dr. rer. nat. Tatia	na Tatarenko	Type Lecture	SWS 2		
	Course nr. 18-ad-2130-ue	Course name Optimization in Multi-Agent Systems	1			
	Instructor Dr. rer. nat. Tatia	na Tatarenko	Type Practice	SWS 1		

Mo Aut	Module name Automation Technology in Process Industries							
Mo 18-	dule nr. ad-2140	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cycle Summer term		
Lar Ger	nguage man/English			Module owner Prof. DrIng. Jürgen Adamy				
1	Teaching co• Funda• Instruct• Actuat• Prozes• Plant s	mentals of process te mentation in process fors for process techn ssleittechnik safety using process o	echnology technology ology control systems					
2	Learning objectives Students will know important process technological machines and apparatus, are able to read P&I diagrams and are aware of requirements for explosion protection. Important automation concepts in process technology are known and students are able to find solutions for similar tasks. Students are familiar with important techniques to measure physical and chemical properties as well as actuators for plant control and known under which conditions these techniques can be applied in a plant. The for these tasks necessary fundamentals in fluid dynamics are understood and can be applied. The principal design of automation systems in process industry is known. This includes hardware setup, network, human machine interface and CAE system. How to connect field instrumentation to such a system is known. With this knowledge students are able design such systems. Students know how PID controllers are realized in a distributed control system (DCS) and they know what to consider when a theoretically calculated controller has to be implemented in a DCS. To ensure plant safety students know how to perform a hazard analysis and they understand the implication of the resulting safety integrity level (SIL) classification on a to be planned automation system. The probability of failure on demand (PFD) calculation is understood and can be applied.							
3	Recomment • Funda • Funda	ded prerequisites fo mentals of electrical mentals of automatic	or participation engineering on					
4	Form of exa Module exam • Modul The examina 20 students will be anno	amination m: e exam (Technical ex ation takes place in fo register, the examina punced in the beginni	amination, Oral/ rm of a written ex tion will be an ora ng of the lecture.	written examinatic am (duration: 90 n al examination (du	on, Duration: 90 Min. ninutes). If one can es ration: 20 min.). The	., Default RS) stimate that less than type of examination		
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 							
7	Usability of M.Sc. MEC,	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	etit - AUT, B.Sc. ur	nd M.Sc. iST			
8	Grade bonu	is compliant to §25	(2)					

9	References						
	 K.F. Früh, U. Maier: Handbuch der Prozessautomatisierung. Oldenbourg Industrieverlag, 6. Auflage 2018 W. Hemming, W. Wagner: Verfahrenstechnik. Vogel Fachbuch, 12. Auflage 2017 M. Engshuber, R. Müller: Grundlagen der Verfahrenstechnik für Automatisierungsingenieure. Deutscher Verlag für Grundstoffindustrie, 2. Auflage 1993 W. Wagner: Regel- und Sicherheitsarmaturen. Vogel Fachbuch 2. Auflage 2023 ABB Library: Broschüren Mess und Analysentechnik. https://library.abb.com/ J. Börcsök: Funktionale Sicherheit. VDE-Verlag, 5. Auflage 2021 						
Co	urses						
	Course nr.Course name18-ad-2140-vlAutomation Technology in Process Industries						
	InstructorTypeSVProf. DrIng. Jürgen AdamyLecture2						

Mo Did	Module name Didactics for Engineers							
Mo	dule nr.	Credit points	Workload	Self-study	Module du	iration	Module cyc	cle
18-	ad-2300	2 CP	60 h	30 h	1 Term		Winter tern	n
Lar Ger	iguage man			Module owner Prof. DrIng. Jür	gen Adamy			
1	Teaching co What is dida training (Du	ntent ctics? What is meth ales System); object	odology? Various ivism and subjecti	didactic models; G vism; grading; tecl	erman educa 1nol-ogy did	ations sys actics	tem in profe	essional
2	 2 Learning objectives Students are able to impart knowledge. A student is, after successful completion of this module, able to understand the difference between didactics an methodology, which didactic models exist, the german educations system in professional training, what important aspects of grading exist. 							
3	Recommended prerequisites for participation							
4	Form of exa Module exan • Module	mination 1: e exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., Def	fault RS)		
5	Prerequisite Pass module	for the award of c final exam	redit points					
6	Grading Module exan • Module	1: e exam (Technical e	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of B.Sc. etit	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References slide copies,	record, current liter	ature (list will bei	provide in lecture)			
Coι	ırses							
	Course nr. 18-ad-2300-y	Course name	Engineers					
	Instructor	1]]]	Fype Lecture		SWS 2

Mo Acc	dule name elerator Physi	cs					
Mo 18-	dule nr. bf-2010	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cy Summer te	cle rm
Lar Ger	iguage man			Module owner Prof. Dr. Oliver B	oine-Frankenheim		
1	Teaching co Beam dynar accelerator o	ntent nics in linear- and c components, measur	ircular accelerato ement of beam pr	rs, working princij operties, high-inter	ples of different acc sity effects and bea	elerator types m current lim	and of its.
2	2 Learning objectives The students will learn the working principles of modern accelerators. The design of accelerator magnets and radio-frequency cavities will discussed. The mathematical foundations of beam dynamics in linear and circular accelerators will be introduced. Finally the origin of beam current limitations will be explained.						
3	Recommended prerequisites for participation BSc in ETiT or Physics						
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation				
6	Grading Module exar • Modul	n: e exam (Technical e:	xamination, Oral e	examination, Weigl	nting: 100 %)		
7	Usability of M.Sc. CE, M	the module .Sc. MedTec, M.Sc. (etit - CMEE				
8	Grade bonu	s compliant to §25	(2)				
9	References Lecture note	s, transparencies					
Coi	ırses						
	Course nr. 18-bf-2010-v	Course namevlAccelerator Ph	ysics				
	InstructorTypeSWSProf. Dr. Oliver Boine-FrankenheimLecture2						

Mo Plas	dule name							
Mo 18-	dule nr. bf-2020	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module dura 1 Term	ation	Module cyc Winter tern	cle n
Lar Ger	nguage man/English			Module owner Prof. Dr. Oliver B	oine-Frankenh	neim		
1	Teaching co The lecture Occurrence description generation -	ntent will cover the follow of plasma in our er of a plasma - waves plasma diagnostics	ing topics: nvironment - defi in plasmas - plas - plasma applicatio	nition of a plasma sma instabilities - ons in the industry.	- particle dyr kinetic descrip	namics ption of	in em fields f a plasma -	s - fluid plasma
2	Learning of The fundmen plasmas sho	jectives ntal properties of pla 11d be worked out a:	smas, waves in pla nd understood by	nsmas as well as the the students durin	interaction of g the course of	electro f this le	magnetic fiel cture.	lds with
3	Recommend	led prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical e:	xamination, Oral e	examination, Weigh	nting: 100 %)			
7	Usability of	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References The transpar	encies can be down	loaded from the T	UCaN site.				
Coi	ırses							
	Course nr. 18-bf-2020-v	Course name Plasma Physic	S					
	InstructorTypeSWSProf. Dr. Oliver Boine-FrankenheimLecture2							

Mo	dule name	1						
App Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lar Ger	nguage man/English	3 CP	90 11	Module owner Prof. Dr. Oliver B	oine-Frankenheim	Summer term		
1	Teaching co	ontent						
	 Kamerligh-Onnes experiment, Meissner effect, London equations Superconductor state diagram (phase diagram) Introduction to Ginzburg-Landau theory (if necessary also: introduction to basic quantum mechanics) Typ I / II Superconductor, Flux quantization, Flux vortices Superconductor magnetization, Hysteresis, Bean's model Cooper pairs (briefly: findings of the BCS theory) AC superconductivity, two fluid model, RF cavities Cooper pair tunneling, Josephson junctions, SQUIDs Applications: Magnets in accelerator and medical technology, precision field and current measurements, superconducting motors, generators, and transformers Experimental demonstration of high temperature superconductors 							
2	Learning objectives The students obtain a phenomenological understanding of superconductivity, which enables them to apply superconductors in engineering practice. Starting from Maxwellian electrodynamics, superconductors are in introduced as perfect conductors at zero frequency. Both their DC and AC properties are discussed. Theory shall be reduced as much as possible. Quantum mechanics is not a requirement for the course, however, simplified quantum mechanical models will be introduced. The focus of the lecture is put on applications, e.g. magnet technology or precision metrology.							
3	Recommen Electrodyna	ded prerequisites fo mics (Maxwell's equa	or participation ations)					
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Oral e	examination, Durat	ion: 30 Min., Defaul	t RS)		
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Oral e	examination, Weigl	nting: 100 %)			
7	Usability of M.Sc. ESE, I	the module M.Sc. etit - EET, M.So	c. WI-etit, M.Sc. C	E, M.Sc. etit - CMI	EE			
8	Grade bonu	is compliant to §25	(2)					
9	References	References						

- W. Buckel, R. Kleiner: "Supraleitung Grundlagen und Anwendungen"; Wiley VCH, 7. Auflage 2013.
- R.G. Sharma; "Superconductivity, Basics and Applications to Magnets"; Springer International Publishing, 2015 (online available).
- H. Padamsee, J. Knobloch, T. Hays: "RF-Superconductivity for Accelerators"; 2nd edition; Wiley VCH Weinheim, 2011.
- P. Seidel (Ed.), "Applied Superconductivity", Wiley VCH Weinheim, 2015.

Courses

00	arbeb			
	Course nr. 18-bf-2030-vl	Course name Applied Superconductivity		
	10 01 2000 11	Applied Superconductivity		
	Instructor		Туре	SWS
	PD DrIng. habil	Uwe Niedermayer	Lecture	2

Mo	dule name							
Nui	nerical Metho	ds of Accelerator Ph	ysics					
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cy	cle
18-	bf-2050	3 CP	90 h	60 h	1 Term		Winter tern	n
Ger	man/English			Prof. Dr. Oliver B	oine-Frank	kenheim		
1	Teaching con	ntent		I				
	 Illustration of accuracy requirements on numerical methods using simple examples from accelerator physics Methods for numerical field computation of accelerating cavities and magnets Stability analysis and eigenvalue problems in accelerator physics Methods for particle tracking in electromagnetic fields Techniques for sampling beam distribution functions Methods for selfconsistent numerical integration of a beam distribution function in electromagnetic fields Surrogate modelling for control room applications Interactive (python) notebooks and example scripts for every discussed method and application 							
2	Learning objectivesAfter successful completion of the module, the students understand basic models of accelerator physics and suitable procedures for their numerical solution and can apply them.							
3	Recommended prerequisites for participation BSc in etit or Physics							
4	Form of exam Module exam • Module	nination a: e exam (Technical e:	xamination, Oral e	examination, Durat	ion: 30 Mi	in., Default	t RS)	
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation					
6	Grading Module exam • Module	n: e exam (Technical e:	xamination, Oral e	examination, Weigh	nting: 100	%)		
7	Usability of M.Sc. ESE, M	t he module I.Sc. MedTec						
8	Grade bonus	s compliant to §25	(2)					
9	References Lecture slides references wi	and material includ ll be given over the	ling example (pytl course of the lect	non) scripts will be ures.	available f	or downloa	ıd. Further lit	erature
Coι	ırses	I						
	Course nr. 18-bf-2050-v	Course name Numerical Me	thods of Accelerat	or Physics				
	Instructor					Type Lecture		SWS 2

Mo	dule name						
Ene	ergy Converte	rs - CAD and System	Dynamics				
Mo 18-	dule nr. bt-2010	Credit points	Workload 210 h	Self-study 135 h	Module duration	Module cycle Winter term	
Lar	iguage	, 31	210 11	Module owner			
Eng	glish			Prof. DrIng. Yve	s Burkhardt		
1	Teaching co Design of ca and tempera ac machines transfer fund and inductio Transient pe	ontent ge-rotor and wound-r ature rise. Transient n s. Theory is illustrate ctions of machines are on motor design are gi erformance calculatio	rotor induction may nachine performar ed by examples: 3 e derived. In the ex iven. The students on is trained by use	chines: Calculation ace of converter-fed Sudden short circu xercise lessons dem design one induction ing Laplace-Transfo	of forces, torque, loss dc machines and line it, load step, run up onstration examples on machine in small g ormation and MATLA	ees, efficiency, cooling e-fed and inverter-fed b. For control design of power transformer groups by themselves. .B.	
2	 Learning objectives Upon successful completion of the module, students will be able to: do and explain the electromagnetic design of an induction machine both analytically and with use of computer program, understand and predict the thermal performance of electrical drives in a simplified way, calculate the instationary performance of separately excited DC drives to predict the dynamical performance of AC polyphase machines with space vector theory and use the MATLAB/Simulink package for this purpose. 						
3	Recommended prerequisites for participation Bachelor of Science in Electrical Engineering, Power Engineering or similar						
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	120 Min., Default RS	5)	
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. MEC,	t he module M.Sc. ESE, M.Sc. eti	it - EET, M.Sc. WI	etit, B.Sc. und M.S	Sc. iST		
8	Grade bonu At the begin lecture that	as compliant to §25 ning of the semester, will enable an impro	(2) it will be annound wement in grades.	ced whether there w	will be homework tes	sts accompanying the	
9	 At the beginning of the semester, it will be announced whether there will be homework tests accompanying the lecture that will enable an improvement in grades. References Detailed textbook and collection of exercises; Complete set of PowerPoint presentation W. Leonhard: Control of electrical drives, Springer Vieweg, 2001 A. Fitzgerald, A. Kusko, C. Kingsley: Electric machinery, McGraw-Hill, 2002 G. McPherson: An Introduction to Electrical Machines and Transformers, Wiley, 1990 M. Say: Alternating Current Machines, Wiley, 1983 M. Say, E. Taylor: Direct Current Machines, Pitman, 1986 P. Vas: Vector Control of AC Machines, Oxford Univ. Press, 1990 D. Novotny, T. Lipo: Vector Control and Dynamics of AC Drives, Clarendon, 1996 						

Co	urses					
	Course nr.Course name18-bt-2010-vlEnergy Converters - CAD and System Dynamics					
	Instructor Prof. DrIng. Yves Burkhardt		Type Lecture	SWS 3		
	Course nr. 18-bt-2010-ue	Course name Energy Converters - CAD and System Dynamics				
	Instructor Prof. DrIng. Yve	es Burkhardt	Type Practice	SWS 2		

Mo Lar	dule name ge Generators	and High Power Dr.	ives					
Mo 18-	dule nr. bt-2020	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module of 1 Term	duration	Module cyc Winter tern	cle n
Lar Ger	nguage rman/English			Module owner Prof. DrIng. Yve	s Burkhard	lt		
1	1Teaching contentDesign of large electric generators: Special cooling methods with air, hydrogen and water, loss evaluation, especially eddy current losses, and measures to reduce the additional losses. Design of big hydrogenerators up to 800 MVA and turbo generators up to 2000 MVA with design examples. Application of power electronics in large variable speed drives with synchronous motors: Synchronous converter and cyclo-converter. Numerous photographs to illustrate applications, excursion with students to special firms or plants.							
2	2 Learning objectives Upon completion of the module, students will have developed an understanding of the design of cooling systems, design principles and operating characteristics of large generators and drives.							
3	Recommended prerequisites for participation Physics, Electrical Machines and Drives, Electrical Power Engineering							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting:	: 100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, B.Sc. und M.S	Sc. iST			
8	Grade bonu	s compliant to §25	(2)					
9	 9 References Detailed textbook with calculated examples; A. Binder: El. Maschinen u. Antriebe: Grundlagen, Betriebsverhalten, Springer Vieweg, 2017 A. Binder: El. Maschinen u. Antriebe: Übungsbuch, Springer Vieweg, 2017 J. Pyrhönen, T. Jokinen, V. Hrabovcova: Design of Rotating Electrical Machines, 2013, Wiley A. Fitzgerald, C. Kingsley, A. Kusko: Electric machinery, McGraw-Hill, 2003 W. Leonhard: Control of electrical drives, Springer Vieweg, 2001 P. Vas: Parameter estimation, condition monitoring, and diagnosis of electrical machines, Clarendon Press, 1993 							
Cot	urses	Courses						
	18-bt-2020-	vl Large Generat	ors and High Pow	er Drives				1
	Instructor Prof. Dr. Geo	org Traxler-Samek				Type Lecture		SWS 2

Course nr. 18-bt-2020-ue	Course name Large Generators and High Power Drives		
Instructor Prof. Dr. Georg T	'raxler-Samek	Type Practice	SWS 1

Mo	dule name tor Developm	ent for Electrical Dri	ve Systems					
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle
18-	bt-2030	4 CP	120 h	75 h	1 Term		Summer ter	rm
Lan Eng	iguage slish			Module owner Prof. DrIng. Yve	s Burkharc	lt		
1	Teaching co For the wide the convention inverter-fed dc drives"), servo drives modular sym	ntent field of the drive tech onal drives and the c induction drives, per synchronous and sw are covered. As a "r chronous motors are	nnology at low and urrent trends of de manent-magnet sy vitched reluctance newcomer" in the e introduced.	medium power ran evelopments are exp rnchronous drives v e drives and perma electrical machines	ge from 1 k blained to t vith and w nent magr s field, the	W up to al he student ithout dan net and ele transversa	bout 500 kW. s. Grid opera oper cage ("br ectrically exci al flux machin	1 MW ted and rushless ited DC nes and
2	 Learning objectives Upon successful completion of the module, students will have knowledge of modern computational methods (e.g. finite elements), advanced materials (e.g. high energy magnets, ceramic bearings), innovative drive concepts (e.g. transversal flux machines) and measurement and experiment techniques 							
3	Recommended prerequisites for participation Lecture "Electrical Machines and Drives"							
4	Form of exa Module exa • Modul	mination m: e exam (Technical e:	xamination, Exam	ination, Duration:	60 Min., D	efault RS)		
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. et	it - EET, M.Sc. WI	-etit				
8	Grade bonu	is compliant to §25	(2)					
9	 References A detailed script is available for the lecture. In the tutorials design of PM machines, switched reluctance drives and inverter-fed induction motors are explained. A. Binder: El. Maschinen u. Antriebe: Grundlagen, Betriebsverhalten, Springer Vieweg, 2017 A. Binder: El. Maschinen u. Antriebe: Übungsbuch, Springer Vieweg, 2017 J. Pyrhönen, T. Jokinen, V. Hrabovcova: Design of Rotating Electrical Machines, 2013, Wiley 							
Cou	ırses	1						
	Course nr. 18-bt-2030-	vl Course name Motor Develop	oment for Electrica	al Drive Systems				1
	Instructor DrIng. And	reas Jöckel				Type Lecture		SWS 2

Course nr. 18-bt-2030-ue	Course name Motor Development for Electrical Drive Systems		
Instructor DrIng. Andreas	Jöckel	Type Practice	SWS 1

Mo Nev	dule name w Technologie	es of Electrical Energy	v Converters and A	Actuators		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Ger	nguage man/English	- FGr	120 11	Module owner Prof. DrIng. Yves Burkhardt		
1	 Application of the superconductors for electrical energy converters: rotating electrical machines (motors and generators), solenoid coils for the fusion research, locomotive- and railway transformers, magnetic bearings. Active magnetic bearings ("magnetic levitation") basics of the magnetic levitation technique, magnetic bearings for high speed drives in kW to MW range, application for high-speed trains with linear drives. Magneto-hydrodynamic energy conversion: physical principle, state of the art and perspectives. Fusion research: magnetic field arrangements for contactless plasma inclusion, state of the current research. 2 Learning objectives After completion of the module students have basic knowledge of application of superconductivity in energy 					
2	 Learning objectives After completion of the module students have basic knowledge of application of superconductivity in energy systems as well as magnetic levitation, magnetohydrodynamics and fusion technology. 					
3	Physics, Elec	trical Machines and	Drives, Electrical	Power Engineering		
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	60 Min., Default RS)	
5	Prerequisit Passing the	e for the award of c	redit points ation			
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, B.Sc. und M.S	Gc. iST	
8	Grade bonu	is compliant to §25	(2)			
9	References Detailed tex • Koman • Bucket • Schwe • Schmi	tbook rek, P.: Hochstroman l, W.: Supraleitung, V itzer, G.; Traxler, A.; dt, E.: Unkonvention	wendungen der S /HS-Wiley, Weinho Bleuler, H.: Magn elle Energiewandl	upraleitung, Teubn eim, 1994 etlager, Springer, E er, Elitera, 1975	er, Stuttgart, 1995 Berlin, 1993	

Co	Courses						
	Course nr. 18-bt-2040-vl	Course name New Technologies of Electrical Energy Converters and Actua	itors				
InstructorTypProf. Dr. techn. Dr.h.c. Andreas BinderLec			Type Lecture	SWS 2			
	Course nr. 18-bt-2040-ue	Course name New Technologies of Electrical Energy Converters and Actua	itors				
	Instructor Prof. Dr. techn. I	Dr.h.c. Andreas Binder	Type Practice	SWS 1			

Mo	dule name	· · ·					
Kai Mo	dulo pr	Gradit nainta	Monthlood	Colf study	Madula duration	Modulo au	
18-	bt-2050	3 CP	90 h	60 h	1 Term	Summer te	rm
Lan Ger	iguage man			Module owner Prof. DrIng. Yve	s Burkhardt		
1	1 Teaching content From the comprehensive and interdisciplinary domain of the railway technology (vehicle technology, signal and safety technology, construction engineering and railway operating technology) the module picks out the domain of the automotive engineering with the emphasis of the mechanical part. It offers an interrelated introduction into selected chapters of the rail vehicle engineering with special emphasis in the railway-specific technical solutions and procedures. Theoretical basics as well as essential components of the rail vehicle are taught in depth.						
2	Learning objectives After completing the module, students will have developed an understanding of the mechanical and mechanical engineering principles of modern rail vehicles.						
3	Recommended prerequisites for participation Bachelor in Electrical Engineering, Mechatronics or Mechanical Engineering						
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 						
5	Prerequisite Passing the f	for the award of c inal module examin	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	it - EET, M.Sc. WI	-etit, B.Sc. und M.S	Sc. iST		
8	Grade bonu	s compliant to §25	(2)				
9	 9 References References/Textbooks: Detailed textbook; Filipovic, Z: Elektrische Bahnen. Springer, Berlin, Heidelberg, 1995. Obermayer, H.J.: Internationaler Schnellverkehr. Franckh-Kosmos, Stuttgart, 1994. 						
Coι	ırses						
	Course nr. 18-bt-2050-v	Course name Railway Vehic	le Engineering				
	Instructor DrIng. Mich	ael Karatas			Type Lecture		SWS 2

Мо	dule name						
Nui	merical simula	ation of electrotherm	al processes				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18- Lar	DL-2070	3 CP	90 h	Module owner	1 Term	winter teri	<u></u>
Ger	man/English			Prof. DrIng. Yve	s Burkhardt		
1	As an introduction, the technical and economic significance of electrothermal process technology is presented using selected examples. In the second part of the lecture, electromagnetic, thermophysical and structural mechanics basics are taught, which are necessary to understand the different electrothermal processes. The main part of the lecture covers the application and design of electrothermal processes, such as inductive heating (emphasis), conductive and dielectric heating, and indirect resistance heating. Practical examples are presented and how they are designed using computer-aided programs (FEM-based numerical simulation models) as well as analytical methods. Within the lecture, simulation models are presented live and analyzed together to visualize and explain the interaction of the respective physical sub-areas of process physics.						
2	Learning objectives Understanding of design and calculation of electrothermal processes and their applications						
3	Recommended prerequisites for participation						
	B.Sc. Electrical Engineering or Mechatronics						
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	xamination, Exam	ination, Duration:	80 Min., Default R	S)	
5	Prerequisite Passing the	e for the award of c final module examination	redit points ation				
6	Grading Module exa • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. ESE, I	t he module M.Sc. etit - EET, M.S	c. WI-etit, M.Sc. C	Œ			
8	Grade bonu	is compliant to §25	(2)				
9	9 References Lecture notes; Fasholz, J., Orth, G.: Induktive Erwärmung, RWE Energie AG, Essen, 4. Aufl., 1991; Nacke, B.; Baake, E. (Hsg.): Induktives Erwärmen, Vulkan-Verlag, 2014						
Coι	urses						
	Course nr. 18-bt-2070-	vl Numerical sim	ulation of electrot	hermal processes			
	Instructor	Neumever			Type Lecture		SWS

Mo Ele	dule name ctric Railways					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18- Lar	pt-2140	5 CP	150 h	Module owner		
Ger	man/English			Prof. DrIng. Yve	s Burkhardt	
1	 The basics of electrical railway traction systems as well as the generation and distribution of electrical power for rail systems will be presented. This includes: Mechanics of traction Electrical part of traction vehicles Converter and motors for electrical traction Monitoring systems Comparison of different power supply systems DC- and AC- systems for light- and heavy rail Problems of earthing and earth return currents Sub stations, converters, power plants 2 Learning objectives 					
2	Learning objectivesAfter completing the module, students will have developed an understanding of the basic concepts of electric traction units and electric traction current systems.					
3	Recommended prerequisites for participation Basic knowledge in electrical machines and drives					
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes) in combination with a presentation. 					
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	Grading Module exar • Modul	n: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %))
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, B.Sc. und M.S	Sc. iST	
8	Grade bonu	s compliant to §25	(2)			
9 Cot	 Grade bonus compliant to §25 (2) References Text book for the lecture. Bendel, H. u.a.: Die elektrische Lokomotive. Transpress, Berlin, 1994. Filipovic, Z: Elektrische Bahnen. Springer, Berlin, Heidelberg, 1995. Steimel, A.: Elektrische Triebfahrzeuge und ihre Energieversorgung. Oldenburg Industrieverlag, 2006. Bäzold, D. u.a.: Elektrische Lokomotion deutscher Eisenbahnen. Alba, Düsseldorf, 1993. Obermayer, H. J.: Internationaler Schnellverkehr. Franckh-Kosmos, Stuttgart, 1994. Guckow, A.; Kiessling, F.; Puschmann, R.: Fahrleitungen el. Bahnen. Teubner, Stuttgart, 1997. Schaefer, H.: Elektrotechnische Anlagen für Bahnstrom. Eisenbahn-Fachverlag, Heidelberg, 1981. 					ustrieverlag, 2006. 993. art, 1997. lelberg, 1981.

Course nr. 18-bt-2140-vl	Course name Electric Railways		
Instructor		Type Lecture	SWS 3

Мо	dule name							
Ele	ctrical Drive S	systems for E-Mobility	у			1		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18- Lor	Dt-2150	5 CP	150 h	90 h	1 Ierm	Summer term		
Ger	man			Prof. DrIng. Yve	s Burkhardt			
1	Teaching co This course components for e-mobility well as know	ontent introduces the stude of electric drive system ty and their design, sy vledge of auxiliary dr	ents the requirem ms, derivation of s ystem effects in th ives in the automo	ents for electric dr ystem requirements ne interaction betw obile.	ive systems for e-mo to individual compon een motor, converter	obility, concepts and nents, electric motors and transmission as		
2	 2 Learning objectives On successful completion of this module, students will be able to Explain the common powertrain configurations of hybrid and electric vehicles, Understand and analyse the requirements and their implications for the design of electric powertrain systems and components, Understand and be able explain the individual components of electric powertrain systems as well as integration and cooling concepts and how they operate, Understand and be able to explain typical electrical machines for electrical drive systems, their characteristics and basic selection and design steps, Understand and interpret the system effects in the interaction of motor, converter and gearbox in the electric drive system. explain the auxiliary drives in passenger cars 							
3	Recommen Mathematic	ded prerequisites fo s I to III, Electrical Eng	or participation gineering and Info	mation Technology	I and II, Physics, Mec	chanical Engineering.		
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	120 Min., Default RS	3)		
5	Prerequisite Pass module	e for the award of ci final exam	redit points					
6	Grading Module exa • Modul	m: e exam (Technical ex	amination, Exam	ination, Weighting:	100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI-	etit				
8	Grade bont At the begin that will ena	as compliant to §25 ning of the semester, i able an improvement	(2) it will be announce in grades.	ed whether there w	ill be short tests accor	mpanying the lecture		
9	References							
	 A. Binder: El. Maschinen u. Antriebe: Grundlagen, Betriebsverhalten, Springer Vieweg, 2017 R. Fischer: Elektrische Maschinen, Carl Hanser Verlag, 2017 G. Müller, B. Ponick: El. Maschinen: 1: Grundlagen, 2014; 2: Berechnung, 2007, Wiley-VCH 							
Ο Οι	ırses		Courses					

Course nr. 18-bt-2150-vl	Course nr.Course name18-bt-2150-vlElectrical Drive Systems for E-Mobility			
Instructor Prof. Dr. Annette	e Mütze, Prof. DrIng. Yves Burkhardt	Type Lecture	SWS 3	
Course nr. 18-bt-2150-ue	Course name Electrical Drive Systems for E-Mobility			
Instructor Prof. Dr. Annette	Mütze, Prof. DrIng. Yves Burkhardt	Type Practice	SWS 1	

Mo	Module name Microsystem Technology						
Mo	dule nr.	Credit points	Workload	Self-study	Module dura	tion Module c	ycle
18-	bu-2010	4 CP	120 h	75 h	1 Term	Winter ter	m
Ger	nguage man			Prof. Ph.D. Thom	as Burg		
1	1 Teaching content Students are able to explain the structure and function of microsystemes for common applications (e.g. pressure sensors, accelerometers, biological and chemical sensors, micro-optical systems), calculate design parameters to achieve given specifications, and to judge the impact of scaling on the device performance. They can select appropriate materials, devise basic fabrication process flows, and identify compatibility issues between processes and/or materials.						
2	2 Learning objectives Students are able to explain the structure and function of microsystemes for common applications (e.g. pressure sensors, accelerometers, biological and chemical sensors, micro-optical systems), calculate design parameters to achieve given specifications, and to judge the impact of scaling on the device performance. They can select appropriate materials, devise basic fabrication process flows, and identify compatibility issues between processes and/or materials.						
3	Recommended prerequisites for participation						
4	Form of exam Module exam • Module	mination 1: e exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., Defau	ılt RS)	
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical ez	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. MEC, I	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, M.Sc. MedTec,	M.Sc. iCE, B.S	Sc. und M.Sc. iST	
8	Grade bonus Up to 1.0 dep	s compliant to §25 pending on problem	(2) sets and course p	articipation			
9	References Lecture notes	s, Moodle course					
Co	ırses						
	Course nr. 18-bu-2010-v	Course namevlMicrosystem T	echnology				
	Instructor Prof. Ph.D. T	homas Burg			Ту р Lec	pe cture	SWS 2
	Course nr. 18-bu-2010-t	Le Microsystem T	echnology				
	Instructor Prof. Ph.D. T	homas Burg			Ty Pra	pe actice	SWS 1

Mo	dule name	toma				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	bu-2030	5 CP	150 h	90 h	1 Term	Summer term
Lar Ger	iguage man			Module owner Prof. Ph.D. Thom	as Burg	
1	Teaching c	ontent		1		
	 Bioanalytical methods Opportunities and fundamental limitations of miniaturization Technology of microfluidic systems The solid-liquid-interface Transport processes Biosensors Single molecule methods PCR-based micro-analytical systems Single-cell sequencing Flow cytometry Optofluidics Organ-on-Chip-Technologies Advanced microscopy techniques 					
2	2 Learning objectives Students will learn to evaluate and compare conventional and microfluidic bioanalytical methods for laboratory medicine and Point-of-Care applications. They become familiar with the underlying physical principles and scaling laws and learn to analyze the impact of miniaturization quantitatively. The skills acquired in this course will enable the participants to select appropriate techniques, to advance knowledge, and to address technological gaps in the biomedical sciences with the help of microfluidic systems.					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul Performanc (<11), an o will be anno	amination m: le exam (Technical e: e will be evaluated b ral exam may be offe ounced at the beginn	kamination, Oral/ pased on a written pred instead (dura ing of each semest	written examinatio final exam (durat tion: 30 min.). The er.	on, Duration: 90 Min. ion: 90 min.). In case mode of the final ex	., Default RS) se of low enrollment cam (written or oral)
5	Prerequisit Passing the	e for the award of c final module examin	redit points ation			
6	Grading Module exa • Modu	m: le exam (Technical e:	xamination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of M.Sc. etit -	f the module SAE, M.Sc. MedTec,	M.Sc. iCE			
8	Grade bonu	is compliant to §25	(2)			
9	References	es and reading assign	ments on Moodle			
Coι	ırses	0 0				

Course nr. 18-bu-2030-vl	Course name Lab-on-Chip Systeme		
Instructor Prof. Ph.D. Thom	nas Burg	Type Lecture	SWS 2
Course nr. 18-bu-2030-ue	Course name Lab-on-Chip Systems		
Instructor Prof. Ph.D. Thom	nas Burg	Type Practice	SWS 2

Mo	dule name	hada fan alaatnama	motio field simula	tion			
1111		nous for electromag			75 1 1 1	30 1 1	1
18-	dule nr. $d\sigma_2 2020$	Credit points	Workload	Self-study 60 h	Module duration	Winter tern	cle
Log	ug-2020	5.61	90 II	Madula auman	1 ICIIII	winter term	
Ger	rman/English			Prof. DrIng. Her	bert De Gersem		
1	Teaching co Finite Differe domain. Hig computing. 1	ntent ence, Finite Volume h order Discontinue Particle based simul	and Finite Elemer ous Galerkin meth ations for beams a	tt Methods for the s ods. Stability and nd plasmas.	solution of Maxwell e convergence analysi	equations in t s. High perfo	he time rmance
2	Learning objectivesStudents lern the theoretical basis of advanced simulation techniques for time dependent electromagnetic fields.Furthermore, the lecture mediates practical skills for the implementation, analysis and application of simulationcodes for common problems of Electrical Engineering						
3	Recommended prerequisites for participation Maxwell's equations, infinitesimal calculus, vector calculus. Basics of differential equations and linear algebra						
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the f	for the award of c nal module examin	e redit points ation				
6	Grading Module exan • Module	n: e exam (Technical e	xamination, Oral e	examination, Weigl	nting: 100 %)		
7	Usability of M.Sc. CE, B.	the module Sc. und M.Sc. iST					
8	Grade bonu	s compliant to §25	(2)				
9	References Lecture slide	s, matlab scripts, va	rious literature so	urces			
Cot	urses	, ,					
	Course pr	Course name					
	18-dg-2020-	I Time domain	methods for electr	omagnetic field sir	nulation		
	Instructor Type SWS Privatdozent Dr. rer. nat. Erion Gionai Lecture 2					SWS 2	

Мо	dule name					
Ele	ctromagnetics	and Differential For	ms			1
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar	nguage	5 CF	90 11	Module owner	1 101111	winter term
Eng	glish			Prof. DrIng. Her	bert De Gersem	
1	1 Teaching content In the recent years, the amount of literature that deals with physical models in terms of differential forms (DF) has increased strongly. For instance, DF allow a clear and elegant representation of electromagnetics (EM). The operators grad, curl, and div of vector analysis are replaced by a single operator of the exterior derivative. Similarly, the integral theorems of Gauss and Stokes are replaced by a single integral theorem. Vector analysis is limited to three dimensions, while DF can be applied to any dimensions. This is useful for the relativistic formulations in four dimensions. Since DF can be canonically integrated over appropriate domains they lend themselves naturally to discretizations of the finite integration type. This lecture series provides an introduction into DF calculus, and its relation to vector analysis. Maxwell's equations and the constitutive relations are expressed in terms of DF, and the main steps into discretization are outlined briefly.					
2	 Learning objectives Students will acquire a detailed understanding of how to describe EM in terms of DF. How "space" (and "time") can be modelled by differentiable manifolds; How a class of physical fields can be represented by differential forms; How Maxwell's equations and constitutive relations translate into the language of DF; How this continuous representation can be discretized. 					
3	Recommen It is recomm • Electro tials); • Vector Gauss	ded prerequisites for nended that the stude omagnetics (Maxwell analysis (scalar and and Stokes).	or participation ents have basic kn 's equations in dif vector fields; diff	owledge about ferential and integr ferential operators	al form; constitutive grad, curl, and div;	relations; EM poten- integral theorems of
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	camination, Oral e	examination, Durat	ion: 30 Min., Defaul	t RS)
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation			
6	Grading Module exa • Modul	m: le exam (Technical ex	camination, Oral e	examination, Weigh	nting: 100 %)	
7	Usability of	the module				
8	Grade bonu	is compliant to §25	(2)			
9	References					

	 M. Fecko: Differential Geometry and Lie Groups for Physicists, Cambridge University Press, 2006 F. Hehl, Y. Obukhov: Foundations of Classical Electrodynamics, Birkhäuser, 2003 K. Jänich: Vector Analysis, Springer, 2001 						
Co	urses						
	Course nr.	Course name					
	18-dg-2030-vl Electromagnetics and Differential Forms						
	Instructor Type SWS Dref. Dr. reg. pat. Schöns, Dref. Dr. Ing. Stafan Kurz Logture 2						

Мо	dule name							
X-R	ay Free Electr	on Lasers	Moulule - 4	Colf otre 1	Madul		Madela	
Mo 18-	dule nr. dg-2110	Credit points 4 CP	Workload 120 h	Self-study 75 h	1 Term	duration	Summer ter	cle rm
Lar	nguage	1.01		Module owner				
Eng	glish			Prof. DrIng. Her	rbert De Ge	ersem		
1	 Optical lasers cannot produce x-rays of photons and high-gain free-electron lasers (FELs) are being developed as extremely bright sources of x-ray radiation. The peak brightness of these facilities exceeds that of other sources by more than ten orders of magnitude. FELs produce hard x-ray beams with very high transverse coherence and femtosecond pulse length. These characteristics open up new areas of x-ray science, such as femtosecond time-domain spectroscopy etc. In this course an overview of the basics of FEL physics is given. We start our discussion from basics principles of particle acceleration and synchrotron radiation, consider the electron motion in an undulator and explain the most important steps to derive the high-gain FEL model. The performance of the high-gain FEL in the linear and the non-linear regimes is considered. The self-amplified spontaneous emission (SASE) option is introduced and characterized. We discuss new schemes for enhancing of the FEL performance. The theoretical considerations in the course are partially illustrated by the results of numerical simulations and experiments. The numerical algorithms are shortly discussed. 							
2	Learning objectives The student should understand the basics of physics of free electron lasers.							
3	Recommended prerequisites for participation Maxwell's equations, integral and differential calculus, vector analysis							
4	Form of examination Module exam: • Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS)							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical e:	xamination, Oral e	examination, Weigl	nting: 100	%)		
7	Usability of	the module						
8	Grade bonu	s compliant to §25	(2)					
9	 References The foils of the lecture will be available at: http://www.desy.de/ zagor/lecturesFEL K. Wille, Physik der Teilchenbeschleuniger und Synchrotron- strahlungsquellen, Teuner Verlag, 1996. P. Schmüser, M. Dohlus, J. Rossbach, Ultraviolet and Soft X-Ray Free-Electron Lasers, Springer, 2008. E. L. Saldin, E. A. Schneidmiller, M. V. Yurkov, The Physics of Free Electron Lasers, Springer, 1999. 							
Cot	urses							
	Course nr. 18-dg-2110-	Course namevlX-Ray Free Ele	ectron Lasers					
	Instructor PD Dr. Igor 2	Zagorodnov				Type Lecture		SWS 2

Course nr. 18-dg-2110-ue	Course name X-Ray Free Electron Lasers		
Instructor PD Dr. Igor Zago	rodnov	Type Practice	SWS 1

Mo	dule name	odynamics for iCF				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	dg-2150	5 CP	150 h	90 h	1 Term	Winter term
Lan Eng	iguage rlish			Prof. DrIng. Her	bert De Gersem	
1	Teaching co	ontent		0		
	 Fundamentals of electromagnetic field theory - Maxwell's equations in differential and integral form; Electromagnetic waves: propagation in free space, polarization, reflection/refraction. Numerical solution of electromagnetic field problems - Space discretization with surface and volume meshes; Main numerical algorithms for discrete local approximation of Maxwell's equations; Finite Integration Technique; Time and frequency domain solution methods; Stability, convergence. Practical aspects of electromagnetic simulation - Introduction to accuracy issues; Preprocessing: 3D geometry, computational domain, boundary conditions, electromagnetic field sources; Time vs frequency domain; Postprocessing; Network parameter extraction. Application to typical high-frequency devices: Waveguide / resonator structures, planar structures 					
2	Learning objectives Students will understand fundamental principles of wave propagation, guided waves and antennas. They will be able to model microwave components with simulation software tools. They will have experience with state of the art software tools for electromagnetic fields.					
3	Recommended prerequisites for participation Fundamentals of electrodynamics (Grundlagen der Elektrodynamik)					
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	amination, Exam	ination, Duration:	180 Min., Default RS	5)
5	Prerequisite Passing the	e for the award of cr final module examina	r edit points ation			
6	Grading Module exa • Modul	m: le exam (Technical ex	amination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. CE, M	t he module I.Sc. iCE				
8	Grade bonu	is compliant to §25	(2)			
9 Coi	 8 Grade bonus compliant to §25 (2) 9 References Course manuscript Additional References: D.K. Cheng: Field and Wave Electromagnetics. Addison-Wesley, New York, 1992 C.A. Balanis: Advanced Engineering Electromagnetics. Wiley, New York, 1989 Andrew F. Peterson et al. Computational Methods for Electromagnetics. Wiley-IEEE Press, 1997. 					

Course nr.Course name18-dg-2150-vlTechnical Electrodynamics for iCE			
Instructor Prof. Dr. Irina M	unteanu, Prof. Dr. Peter Thoma	Type Lecture	SWS 2
Course nr. 18-dg-2150-ue	Course name Technical Electrodynamics for iCE		
Instructor Prof. Dr. Irina M	unteanu, Prof. Dr. Peter Thoma	Type Practice	SWS 2

Mo Sin	dule name	am Dynamics and Ele	ectromagnetic Fiel	ds in Accelerators		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lai	nguage	5 CP	90 II	Module owner	1 101111	Summer term
Ger	rman/English			Prof. DrIng. Her	bert De Gersem	
1	 The lecture provides an overview of the numerical modeling of charged particles and electromagnetic fields in accelerators. The focus is on the simulation of collective effects caused by space charge interaction and/or by electromagnetic wake fields. The lecture is aimed at master's students specializing in various fields of electrical engineering and physics. These include electromagnetic field theory, computational engineering, and computational physics and accelerator physics. Contents of the lecture are: Particle tracking methods: types of particle methods, relationship to Vlasov model Integration of equations of motion: Boris pusher, numerical stability, symplecticity Electrostatic PIC: Green functions, FFT and FD methods, charge deposition, field interpolation, spline shape functions DC-gun simulation: space charge limited emission - Tracking in the Lorenz frame - Map based tracking methods Electromagnetic PIC: FDTD method, charge-conserving current deposition, Boris scheme, low dispersion methods Wakefields and impedances: simulation of ultra-relativistic beams - Plasma Wakefield Acceleration - Parallel computing 					
2	Learning ol Upon compl particles and modern sim simulation to	ojectives etion of the module, d electromagnetic fie ulation techniques in pols and know their a	students will have elds in accelerator n accelerator tech dvantages and dis	e gained an overvie rs. They have beer nology. The studer advantages, as well	ew of the numerical n n given a solid found nts have gained insig as the corresponding	modeling of charged lation in the field of th into the different areas of application.
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Oral e	xamination, Durat	ion: 30 Min., Defaul	t RS)
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exan • Modul	m: e exam (Technical ex	αamination, Oral ε	xamination, Weigh	nting: 100 %)	
7	Usability of M.Sc. CE, M	the module I.Sc. etit - CMEE				
8	Grade bonu	is compliant to §25	(2)			
9	References					
Co	urses					

Course nr. 18-dg-2170-vl	Course name Simulation of beam dynamics and electromagnetic fields in	accelerators				
Instructor Prof. Dr. Oliver B	oine-Frankenheim, Privatdozent Dr. rer. nat. Erion Gjonaj	Type Lecture	SWS 2			
Mo Fin	dule name ite Element M	lethod				
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Mo 18-	dule nr. dg-2180	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration 1 Term	Module cycle Summer term
Lar Eng	iguage glish	1	I	Module owner Prof. DrIng. Her	bert De Gersem	I
1	1 Teaching content					
	 Fundamentals of the finite element method: weighted residuals, projection methods, variational formulations, weak formulations; finite elements (definitions, classification, first order Whitney element complex, higher order elements); convergence and accuracy. Implementation details: data structures, matrix assembly, system solving, postprocessing. Application to electromagnetic problems: electrostatics, magnetostatics, stationary currents, magnetoquasistatics, electroquasistatics, wave propagation. 					
2	2 Learning objectives Students will master the theoretical basics of finite element methods. They understand details regarding the implementation of the method for static, quasistatic and propagating fields. They can apply the finite element method in electrical engineering.					
3	Recommend Maxwell's ed algebra.	ded prerequisites fo quations, infinitesim	or participation al calculus, vector	r calculus, basics o	f partial differential e	equations and linear
4	Form of exa Module exar • Modul	mination n: e exam (Technical e:	amination, Oral e	examination, Durat	ion: 30 Min., Default	t RS)
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral examination, Weighting: 100 %) 					
7	Usability of M.Sc. CE, M	the module .Sc. etit - CMEE				
8	Grade bonu	s compliant to §25	(2)			
9	References					

- Lecture slides.
- Willi Törnig, Michael Gipser, Bernhard Kaspar. Numerische Lösung von partiellen Differentialgleichungen der Technik: Differenzenverfahren, Finite Elemente und die Behandlung großer Gleichungssysteme. Teubner, 1991.
- Rolf Steinbuch. Finite Elemente Ein Einstieg. Springer, 1998.
- Alain Bossavit. Computational electromagnetism: variational formulations, complementarity, edge elements. Academic Press, 1997.
- Klaus Knothe, Heribert Wessels. Finite Elemente: Eine Einführung für Ingenieure (3. Aufl.). Springer, 1999.
- P. P. Silvester, R. L. Ferrari. Finite Elements for Electrical Engineers, Cambridge University Press, 1991.
- O. C. Zienkiewicz, R. L. Taylor. The finite element method (4. ed.). McGraw-Hill, 1989.

Co	urses			
	Course nr. 18-dg-2180-vl	Course name Finite Element Method - Lecture		
	Instructor Prof. Dr. Irina Munteanu		Type Lecture	SWS 2
	Course nr. 18-dg-2180-pr	Course name Finite Element Method - Laboratory		
	Instructor Prof. DrIng. Herbert De Gersem		Type Lab	SWS 2

Mo Virt	dule name	ng of Flectric Drives					
Mo	dule nr	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	dg-2190	6 CP	180 h	120 h	1 Term	Summer term	
Lan Eng	i guage glish			Module owner Prof. DrIng. Her	bert De Gersem		
1	Teaching co	ontent					
	 Basics of electric machine theory lassification of electric machine types Basic principles of electric machine modelling and simulation Embedding material models Geometry approximation and field modelling Field-circuit coupling and transient simulation Finite elements for multiphysics Optimization methods Simulation environments Laboratory measurements on electric machines 						
2	2 Learning objectives The students get acquainted with modern techniques for modelling, simulating and optimizing electric machines. They know the strengths and weaknesses of available design tools and are able to critically assess simulation results. They consider electromagnetic fields and their coupling to structural, thermo- and fluiddynamics. They are able to specify the virtual prototyping problem, choose the appropriate simulation tools, set up the models, and avantually askes the problems, including application of modern entimization tools.						
3	Recommend Basics of fiel linear algebr	ded prerequisites fo d and circuit simula ^r a.	r participation tion, electromagn	etic field theory, ba	asics of partial differ	ential equations and	
4	Form of exa Module exar • Modul The grade co	mination n: e exam (Technical ex onsists of a report an	amination, Oral/ d a presentation f	written examinatio ollowed by a quest	on, Default RS) ion and answer sessio	on.	
5	Prerequisite Passing the f	e for the award of c final module examina	redit points ation				
6	GradingModule exam:Module exam (Technical examination, Oral/written examination, Weighting: 100 %)						
7	Usability of M.Sc. etit - I	the module EET, M.Sc. WI-etit, B	.Sc. und M.Sc. iS	Г			
8	Grade bonu	s compliant to §25	(2)				
9	References						

- Lecture slides.
- J.P. Bastos, Electromagnetic Modeling by Finite Element Methods, Marcel Dekker Ltd. 2003.
- N. Bianchi, Electrical Machine Analysis Using Finite Elements, Taylor & Francis, 2005.
- J. Frochtze, Finite-Elemente-Methode, Hanser, 2021.
- M. Kaltenbacher, Numerical Simulation of Mechatronic Sensors and Actuators: Finite Elements for Computational Multiphysics, Springer, 2015.
- S. Salon, Finite Element Analysis of Electrical Machines, Kluwer, 1995.

00	arbeb						
	Course nr. 18-dg-2190-vl	Course nr.Course name18-dg-2190-vlVirtual Prototyping of Electric Drives - Lecture					
	Instructor Prof. DrIng. Her	bert De Gersem, Prof. Dr. rer. nat. Sebastian Schöps	Type Lecture	SWS 2			
	Course nr. 18-dg-2190-pr						
	Instructor Prof. DrIng. He Sebastian Schöps	rbert De Gersem, Prof. Dr. Annette Mütze, Prof. Dr. rer. nat. 5, Prof. Dr. Dr.h.c. Manfred Kaltenbacher	Type Lab	SWS 2			

Mo Ser	dule name					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	de-2050	6 CP	180 h	120 h	1 Term	Summer term
Lan Ger	i guage man/English			Module owner PD DrIng. Stefa	n Göbel	
1	 Teaching content Introduction to the topic of ""Serious Games"": scientific and technical foundations, application areas and trends. Individual lectures include: Introduction to Serious Games Game Development, Game Design Game Technology, Tools and Engines Personalization and Adaptation Interactive Digital Storytelling Authoring and Content Generation Multiplayer Games Game Interfaces and Sensor Technology Effects, Affects and User Experience Mobile Games Serious Games Application Domains and Best Practice Examples 					
	The exercise	e consists of theoretic	al and practical p	arts. Students are t	aught how to use a (Game Engine.
2	Learning objectives After successfully completing this course the students are able to explain the concept of "Serious Games" and can transfer it to different application domains (like education or health). They can describe the general approach for developing computer games and can apply basic principles of game design, personalisation / adaptation and interactive digital storytelling. Aside from that students are able to sketch out other current research questions regarding Serious Games as well as their solutions.					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exam • Modul The examina 8 students r will be anno	amination m: e exam (Technical ex ation takes place in fo egister, the examinat ounced in the beginni	kamination, Oral/ orm of a written ex ion will be an ora ing of the lecture.	written examinatio am (duration: 90 n l examination (dur	on, Duration: 90 Min. ninutes). If one can es ation: 30 min.). The	., Default RS) stimate that less than type of examination
5	Prerequisit Pass exam (e for the award of c 100%)	redit points			
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Oral/	written examinatio	on, Weighting: 100 %))
7	Usability of M.Sc. etit - I	the module DT, M.Sc. CE, B.Sc. C	CE, M.Sc. iCE, B.S	c. und M.Sc. iST, E	B.Sc. WI-etit	
8	 Grade bonus compliant to §25 (2) In dieser Vorlesung findet eine Anrechnung von vorlesungsbegleitenden Leistungen statt, die lt. 25 (2) der 5. Novelle der APB und den vom FB 20 am 30.3.2017 beschlossenen Anrechnungsregeln zu einer Notenverbesserung um bis zu 1.0 führen kann. 					
9	References					

	Will be given in	ecture.		
Co	urses			
	Course nr. 18-de-2050-vl	Course name Serious Games		
	Instructor PD DrIng. Stefa	n Göbel	Type Lecture	SWS 3
	Course nr. 18-de-2050-ue	Course name Serious Games		
	Instructor PD DrIng. Stefa	n Göbel	Type Practice	SWS 1

Mo	dule name	outed Cyber-Physical	Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
Lan Ger	n-2020 nguage man/English	0 Cr	100 11	Module owner Prof. DrIng. Roli	f Findeisen	Summer term	
1	1 Teaching content Cyber-physical systems and multi-variable systems: Aspects and fundamentals of multivariable, interconnected, and cyber-physical systems, control & systems theory concepts (stabilizability, controllability, observability, detectability, reachability, resilience, control & estimation of multivariable systems), systems and graphs, networked control systems (control & estimation over communication networks, control subject to delays/to information loss, security, safety, and privacy), control of interconnected/multi-agent systems (centralized, decentralized & distributed control, consensus, synchronization), hierarchical control (fundamentals, optimization, time scale separation, hierarchical control concepts, optimization based control & real-time optimization)						
2	2 Learning objectives The students are familiar with the basic analysis and control methods for multivariable systems, networked control systems, and interconnected systems and their applications. They are able to model and analyse multivariable, interconnected systems, and networked control systems subject to delays, communication loss. Furthermore, they are able to design basic centralized, decentralized, distributed, hierarchical controllers and estimators, as well as controllers to achieve consensus and synchronization control. They are familiar with the concept of time-scale seperation for control and estimation.						
3	Recommended prerequisites for participation Basic concepts of control theory. Fundamentals of linear algebra, differential and difference equations.						
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If less than 25 students register, the examination will be an oral examination (duration: 25 min.). The type of examination will be announced in the beginning of the lecture 						
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	Grading Module exan • Modul	n: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	CE, M.Sc. etit - A	UT, B.Ed. etit, B.So	. und M.Sc. iST, M.S	Sc. etit - VAS	
8	Grade bonu	is compliant to §25	(2)				
9	References						
	 S. Skogestad, I. Postlethwaite, Multivariable Feedback Control, Wiley, 2005. J. Lunze (Ed.), Control Theory of Digitally Networked Dynamic Systems, Springer, 2014. J. Lunze. Networked Control of Multi-Agent Systems, Bookmundo Direct, 2019. M. Mesbahi, M. Egerstedt. Graph Theoretic Methods in Multiagent Networks, Princeton University Press. 						
Cοι	ırses						

Course nr. 18-fi-2020-vl	Course name Control of Distributed Cyber-Physical Systems		
Instructor Prof. DrIng. Rolf Findeisen		Type Lecture	SWS 3
Course nr. 18-fi-2020-ue	Course name Control of Distributed Cyber-Physical Systems		
Instructor Prof. DrIng. Rol	f Findeisen	Type Practice	SWS 1

Mo Mo	dule name deling, Simul	ation, and Optimizat	ion					
Mo	dule nr. fi-2030	Credit points	Workload 210 h	Self-study	Module d	luration	Module cyc	cle
Lar Ger	nguage man/English	, 01	210 11	Module owner Prof. DrIng. Rol	f Findeisen			
1	1 Teaching content Physics-based modeling, modeling of distributed parameter systems, model simplification, linearization, model reduction, numerical integration methods, static and dynamic optimization, parameter optimization, data-driven modeling, machine learning supported modeling.							
2	2 Learning objectives The students are familiar with different modeling approaches for dynamical systems and can apply those to various fields of applications. They acquire the ability to simulate the dynamical behavior of the modeled systems. They can select and use suitable integration methods. They can perform a model reduction and decompose dynamical systems. They acquire the fundamental knowledge of static and dynamic optimization of systems. The obtain a perspective on data-driven and machine learning supported modeling.							
3	Recommen Basic concep	ded prerequisites for ots of control theory.	or participation Fundamentals of	linear algebra.				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS) The examination takes place in form of a written exam (duration: 120 minutes). If one can estimate that less than 25 students register, the examination will be an oral examination (duration: 25 min.). The type of current will be ensured in the basis of the lecture 							
5	Prerequisit Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	m: le exam (Technical e:	xamination, Oral/	written examinatio	on, Weightir	ng: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	etit - AUT, B.Sc. ur	nd M.Sc. iS	T, M.Sc. e	tit - VAS	
8	Grade bonu	is compliant to §25	(2)					
9 Coi	 9 References P.E. Wellstead. Introduction to Physical Systems Modeling. Academic Press. L. Grüne, O. Junge. Gewöhnliche Differentialgleichungen. Springer Spektrum. G.F. Franklin, J.D. Powell and A. Emnami-Naeini. Feedback Control of Dynamical Systems, Addison-Wesley. C.a. Athanasios. Interpolation Methods for Model Reduction. SIAM. 							
	Course nr. 18-fi-2030-v	Course name Modeling, Sim	ulation, and Opti	mization				
	Instructor Prof. DrIng	. Rolf Findeisen, Dr.	Ing. Eric Lenz			Type Lecture		SWS 3

Course nr. 18-fi-2030-ue	Course name Modeling, Simulation, and Optimization		
Instructor Prof. DrIng. Rol	f Findeisen, Dr. Ing. Eric Lenz	Type Practice	SWS 2

Mo Mo	dule name del Predictive	Control and Machin	e Learning			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	fi-2040	4 CP	120 h	75 h	1 Term	Winter term
Lar Eng	iguage dish			Module owner Prof. DrIng. Roli	f Findeisen	
1	1 Teaching content Lecture: Introduction and basics of optimal control, Linear Quadratic Regulator (LQR) in discrete and continuous time, basics of model predictive control (cost functions, constraints, receding horizon), nominal model predictive control for linear systems, robust and stochastic model predictive control, model predictive control of nonlinear systems, combination of machine learning and model predictive control. Group work: In a group project, the students will apply the learned. The group project evolves a review of state of the art for the selected task, the selection of suitable model predictive control approach, and the implementation using python/Matlab. It includes a project report and is concluded by a project presentation.					
2	2 Learning objectives The students will understand the basics concepts of model predictive control. Furthermore, they are familiarized with machine learning approaches that can support model predictive controllers and possibly enhance the controller performance. This entails knowledge about theoretical questions such as stability in the nominal case, as well as extensions to the case of uncertain and disturbed systems. The students are enabled to design and implement model predictive controllers based on first principle/physical or data-based/machine learning based models. This entails the setup and design of the control structure as well as the tuning and identification of suitable parameters and cost functions of the controller.					
3	Recommen Basic concep edge in Pyth	ded prerequisites fo pts of control theory. non and/or Matlab.	or participation Fundamentals of I	linear algebra, diffe	erential, and differen	ce equations. Knowl-
4	Form of exa Module exa • Modul The examina 25 students will be anno	amination m: le exam (Technical ex ation takes place in fo register, the examina bunced in the beginni	kamination, Oral/ orm of a written ex tion will be an ora ing of the lecture.	written examinatio am (duration: 90 m al examination (dur	n, Duration: 90 Min. iinutes). If one can es ation: 25 min.). The	, Default RS) stimate that less than type of examination
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 					
7	Usability of M.Sc. MEC,	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, M.Sc. etit - AU	T, B.Sc. und M.Sc. iS	ST, M.Sc. etit - VAS
8	Grade bonu Yes. Possibil	is compliant to §25 lity to improve the gr	(2) ade by a group we	ork/exercise.		
9	References					

- J. Rawlings, D. Mayne, and M. Diehl. Model predictive control: theory, computation, and design. Nob Hill Publishing.
- S. Raković, and W. Levine. Handbook of Model Predictive Control. Birkhäuser, 2018.

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	Course nr. 18-fi-2040-vl	Course nr.Course name18-fi-2040-vlModel Predictive Control and Machine Learning					
	Instructor Prof. DrIng. Rolf Findeisen		Type Lecture	SWS 2			
	Course nr.Course name18-fi-2040-ueModel Predictive Control and Machine Learning						
	Instructor Prof. DrIng. Rolf Findeisen, M.Sc. Maik Pfefferkorn, M. Eng. Hoang Nguyen		Type Practice	SWS 1			

Mo Ma	dule name chine Learnin	g for Mechatronic an	d Dynamical Syst	ems		
Mo 18-	dule nr. fi-2060	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration	Module cycle Summer term
Lar	nguage			Module owner	(r . 1 .	1
Eng	glish	ntont		Prof. DrIng. Rol	f Findeisen	
	<i>Lecture:</i> The lecture introduces the fundamental concepts of machine learning, focusing on applications in mechatronics and dynamical systems, including data-driven and hybrid modeling, simulation, monitoring, planning, decision making, optimization, and control.					ions in mechatronics g, planning, decision
	<i>Content:</i> Machine learning in mechatronics and dynamical systems?; basics of machine learning; review of dynamical systems with a machine learning perspective; machine learning - an optimization perspective; regression; feature generation; clustering (regression and non-regression based); support vector machines; Gaussian processes; inference; Neural Networks (feed-forward, recurrent neural networks, training of neural networks, deep-learning); re-enforcement learning; optimal control and re-enforcement learning; machine-learning for embedded systems; safety and reliability of machine learning for dynamical systems; application examples from monitoring, fault detection, simulation, optimization of complex mechatronic systems, robotics, planning, autonomous driving.					
	Group exerci In a group v systems pro the selection Python/Mat	<i>se/group work:</i> work, the students w oblems. The group n of suitable machin lab. It includes a pro	ill apply the learn work involves a ne learning and o ject report and a j	ned concepts and r review of state-of decision-making m project presentation	nethods to mechatro f-the-art methods fo nethods, and the im n.	onics and dynamical or the selected task, aplementation using
	The module	is offered jointly by I	Prof. Rolf Findeise	en, Prof. Jürgen Ad	amy, Prof. Jan Peters	
2	After succes focusing on and dynamic monitoring,	sful participation in mechatronic and dyn- cal systems application and control.	this module, the amical systems; se hs; apply machine	students can: und lect and evaluate n learning algorithms	lerstand the basics on nachine learning met for modeling, decision	of machine learning, hods for mechatronic ons making, planning,
3	Recomment Basic concept edge in Pyth	ded prerequisites fo ots of control theory. non and/or Matlab.	r participation Fundamentals of I	linear algebra, diffe	erential, and differen	ce equations. Knowl-
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less th 25 students register, the examination will be an oral examination (duration: 25 min.). The type of examination will be announced in the beginning of the lecture. 				., Default RS) stimate that less than type of examination	
5	 Prerequisite for the award of credit points Passing the final module examination 					
6	 6 Grading Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)))	
7	Usability of	the module				

	M.Sc. MEC, M.Sc. WI-etit, M.Sc. etit - AUT, M.Sc. etit - VAS					
8	Grade bonus compliant to §25 (2)					
	Yes. Possibility to	o improve the grade by a group work/exercise.				
9	References					
	 Brunton, Steven L., and J. Nathan Kutz. Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press, 2019. D. Bertsekas. Reinforcement Learning and Optimal Control. Athena Scientific, 2019. K. P. Murphy. Probabilistic Machine Learning: An Introduction. MIT Press, 2022. 					
Cot	urses					
	Course nr.	Course name				
	18-fi-2060-vl	Machine Learning for Mechatronic and Dynamical Systems				
	Instructor		Туре	SWS		
	Prof. DrIng. Rol	f Findeisen	Lecture	2		
	Course nr.	Course name				
	18-fi-2060-pr Machine Learning for Mechatronic and Dynamical Systems					
	Instructor Type SWS					
	Prof. DrIng. Ro	f Findeisen	Lab	2		

Mo Mu	Module name Multivariable and Robust Control						
Mo	dule nr. fi-2070	Credit points	Workload	Self-study	Module duration	Module cy	cle
Lar	nguage	0.01	100 11	Module owner	f Findeisen	Whiter term	
1	Teaching co	ontent		1101. DIIng. 101			
	 Basics (MIMO systems, SVD, system norms) Controller design for multivariable systems H2 and H8 Control design in the frequency domain Robust Control (uncertainty description, robustness analysis, robust controller design) 						
2	Learning of The student express cont form and to	ojectives s are able to formula rol tasks as H2 and l design a controller v	te, analyse, and d H8 optimization p vhich ensures rob	esign controllers for roblems, to represe ust stability and ro	or multivariable syste ent uncertainities of a bust performance.	ems. They are a system in a s	able to suitable
3	Recomment System Dyna	ded prerequisites for amics and Automatic	or participation Control Systems	I and II			
4	Form of exa Module exa • Modul The examina 25 students will be anno	mination n: e exam (Technical ex ation takes place in fo register, the examina unced in the beginn	xamination, Oral/ orm of a written ex tion will be an ora ing of the lecture.	written examinatio am (duration: 90 n al examination (dur	n, Duration: 90 Min hinutes). If one can e ration: 25 min.). The	., Default RS) stimate that le type of exam) ess than nination
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation				
6	Grading Module exame Modul	n: e exam (Technical e:	xamination, Oral/	written examinatio	n, Weighting: 100 %	b)	
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	etit - AUT, B.Sc.	und M.Sc. iST, M.S	c. etit - VAS		
8	Grade bonu	s compliant to §25	(2)				
9	References						
	 S. Skogestad, I. Postlethwaite, Multivariable Feedback Control,2. Auflage, 2005, Wiley K. Zhou, Essentials of Robust Control, 1998, Prentice-Hall O. Föllinger, Regelungstechnik, 11. Auflage, 2013, VDE Verlag 						
Cot	urses	Course and the					
	Course nr. 18-fi-2070-v	l Multivariable	and Robust Contro	ol			
	Instructor Dr. Ing. Eric	Lenz			Type Lecture		SWS 3

Course nr. 18-fi-2070-ue	Course name Multivariable and Robust Control		
Instructor Dr. Ing. Eric Lenz	Z	Type Practice	SWS 1

Mo Dat	dule name a-driven Mod	elling of Dynamic Sy	rstems			
Mo	dule nr. fi-2081	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration	Module cycle Summer term
Lan Ger	n guage man			Module owner Prof. DrIng. Rol	f Findeisen	
1	Teaching co	ontent				
	 Important topics of signal processing and stochastics Disturbance and excitation signals Identification of linear systems Non-parametric identification (Frequency response estimation) Parametric identification (Characteristic values, Output error and equation error minimization, Sul space method, Kalman filter) Recursive methods Closed loop identification Basics of data-driven modelling of non-linear systems 					or minimization, Sub-
2	Learning of The student tions on the and apply ap	ojectives s are taught the func system and constrain opropriate methods to	lamental methods nts imposed by the o generate non-pa	of data-driven mode measurements, th rametric and param	delling (identification e students are able to hetric models from the	n). Based on assump- o select, parametrize e measurement data.
3	Recommen Basics in the	ded prerequisites fo e field of control engi	or participation neering (e.g. lectu	ıre System Dynami	cs and Automatic Co	ntrol Systems I)
4	Form of exa Module exam • Modul The examina 25 students will be anno	mination m: e exam (Technical ex ation takes place in for register, the examina unced in the beginni	kamination, Oral/ orm of a written ex tion will be an ora ing of the lecture.	written examinatio am (duration: 90 m al examination (dur	n, Duration: 90 Min. hinutes). If one can es ration: 90 min.). The	, Default RS) stimate that less than type of examination
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exa • Modul	m: e exam (Technical e:	kamination, Oral/	written examinatio	n, Weighting: 100 %))
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. WI-etit, N	1.Sc. CE, M.Sc. et	it - AUT, B.Sc. und	M.Sc. iST, M.Sc. etit	- VAS
8	Grade bonu	s compliant to §25	(2)			
9	References					
	 Pintelon, R.; Schoukens, J.: System Identification: A Frequency Domain Approach. IEEE Press, New Yor 2001. Ljung, L.: System Identification: Theory for the user. Prentice Hall information and systems sciences series Prentice Hall PTR, Upper Saddle River NJ, 2. edition, 1999. 				EEE Press, New York, stems sciences series.	
Coι	ırses					

Course nr. 18-fi-2080-vl	Course name Data-driven Modelling of Dynamic Systems		
Instructor Dr. Ing. Eric Lenz		Type Lecture	SWS 2
Course nr. 18-fi-2080-ue	Course name Data-driven Modelling of Dynamic Systems		
Instructor Dr. Ing. Eric Len	Z	Type Practice	SWS 1

Mo Bas	dule name ics of Biophot	conics				
Mo 18-	dule nr. fr-2010	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Summer term
Lar Ger	nguage man/English		I	Module owner Prof. Dr. habil. To	orsten Frosch	1
1	1 Teaching content Review of the fundamentals of optics, laser technology, light-matter interaction, and spectroscopic systems, covering medical applications such as photodynamic therapy and optical heart rate measurement etc.; spectroscopy and imaging with linear optical processes: IR absorption, Raman spectroscopy, with applications e.g. in breath analysis, drug quality control, as well as detection of biomarkers; laser microscopy, e.g. wide-field microscopy Raman microscopy and chemical imaging, fluorescence microscopy, with applications e.g. in neurostimulation research; spectroscopy and imaging with nonlinear optical processes: fundamentals of nonlinear optics, multiphoton fluorescence, e.g., with application for in vivo imaging of the brain, coherent nonlinear optical processes such as SHG and CARS, multimodal imaging, e.g. with potential application in intra-operative tumor imaging.					
2	Learning of Students get the underlyi and underst knowledge, Furthermore	ojectives to know established ng concepts. They are and the principles o the students will be a e, they will be able to	and state of the and e familiar with line of spectroscopy and able to evaluate and precommend appr	rt biophotonic syste ear and nonlinear o id microscopy base nd compare commo opriate techniques	ms in medical techno ptical processes of lig of on them. With the on biophotonic metho and methods for a p	logy and understand ht-matter interaction e help of the gained ods and instruments. articular application.
3	Recomment Physics for H	ded prerequisites fo Electrical Engineering	or participation g and Mathematic	s I (Electrical Engir	eering)	
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	MedTec, B.Sc. ur	nd M.Sc. iST		
8	Grade bonu	is compliant to §25	(2)			
9	References • Kramme, Medizintechnik - Chapter Biomedizinische Optik (Biophotonik), Springer • Gerd Keiser, Biophotonics: Concepts to Applications, Springer • Lorenzo Pavesi, Philippe M. Fauchet, Biophotonics, Springer • Jürgen Popp, Valery V. Tuchin, Arthur Chiou, Stefan H. Heinemann, Handbook of Biophotonics, Wiley-VCH					
00	11 585					

Course nr. 18-fr-2010-vl	Course nr.Course name18-fr-2010-vlBasics of Biophotonics					
Instructor		Type	SWS			
Dr. rer. nat. Andreas Merian, Prof. Dr. habil. Torsten Frosch, M.Sc. Phil Reize		Lecture	2			
Course nr. 18-fr-2010-ue	Course name Basics of Biophotonics					
Instructor	Type	SWS				
Dr. rer. nat. And	Practice	1				

Mo Fur	Module name Fundamentals and Technology of Radiation Sources for Medical Applications					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Ger	nguage man/English	5.01	150 11	Module owner Prof. DrIng. Chr	istian Graeff	winter term
1	I Teaching content The course covers the following topics: • Types of radiation • Overview of radiation sources in medicine • Basics of particle acceleration • X-ray tubes • Particle accelerators and applications in medicine • Radionuclide production • Irradiation devices and facilities in medicine					
2	2 Learning objectives The students know the types of radiation relevant to medicine, their properties and their generation. The simpl X-ray tube as an introductory example is understood in its function. The basic principles of modern particl accelerators for direct or indirect irradiation are understood and the different types of accelerators for medicin can be distinguished. The generation processes of radionuclides and their application in facilities for irradiatio are understood					eneration. The simple s of modern particle lerators for medicine cilities for irradiation
3	Recommen 18-kb-1040	ded prerequisites fo Applications of Elect	r participation rodynamics			
4	Form of exa Module exam • Modul The examin- register, the beginning of	mination n: e exam (Technical ex ation is a written exa examination will be f the course.	amination, Oral/ am (duration: 120 oral (duration: 4	written examinatio) min.). If it is fore 5 min.). The type	n, Duration: 120 Mir sseeable that fewer tl of examination will l	n., Default RS) han 21 students will be announced at the
5	Prerequisite Passing the	e for the award of c final module examina	r edit points ation			
6	Grading Module exan • Modul	n: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %))
7	Usability of M.Sc. CE, M	the module Sc. MedTec				
8	Grade bonu	s compliant to §25	(2)			
9	References					
	• Strahlungsquellen für Technik und Medizin, Hanno Krieger, Springer (2014)					
Coι	ırses					

Course nr. 18-gr-2010-vl	enr.Course name0010-vlFundamentals and technology of radiation sources for medical applications				
Instructor		Type	SWS		
Prof. DrIng. Christian Graeff		Lecture	2		
Course nr. 18-gr-2010-ue	Course name Fundamentals and technology of radiation sources for medic	al applications			
Instructor		Type	SWS		
Prof. DrIng. Christian Graeff		Practice	2		

Mo Ion	dule name Beam Therap	у				
Mo 18-	dule nr. gr-2020	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Summer term
Lar Ger	iguage man/English			Module owner Prof. DrIng. Chr	ristian Graeff	
1	 Teaching content Ion Beam Therapy is a cutting edge tool to treat cancer. Ion beams offer unique properties to tailor the dose to deep-seated targets inside the human body, while sparing surrounding healthy tissue. Their finite range, sharp dose gradients and increase radiobiological efficacy offer the potential for improved treatment options, but also pose high demands on precision and further research to be optimally implemented in clinical practice. This course addresses the following topics: Basics of physics and radiobiology of ion beams Typical ion beam therapy centers Production of ion beams for therapy 					
	 Ion be Ion be Dose c Image Irradia Monito This lecture algorithms i exercises, whiin ion beam 	am monitors and det calculation and treatr guidance ation of moving organ oring of beam applica s handles both the us in treatment plannin here students will lear therapy and research	rectors nent planning ation and range in ser perspective as g and application m to use public dor n.	n the patient well as technical r Theoretical found nain software for tr	realization of real-tin dations will be accor eatment planning for	ne beam control and npanied by practical different applications
2	Learning of After succes beams that j accelerators beam scanni they can cor The student sources of u	ojectives sful completion of th ustify their use in can for ion beam product ing, including hardwa induct basic treatment is know advantages a ncertainty in their ap	ne module, studen ncer therapy. They ion. The students are and algorithms planning, evalua and challenges of oplication.	nts know the phys and can describe exist learned methods to used in real-time the te treatment plans ion beam therapy	ical and radiobiologi ing clinical facilities a paply ion beams to p herapy control. Using and judge their robu as well as strategies	ical properties of ion and understand their patients, in particular the program matrad, istness in application. addressing relevant
3	Recomment Radiation so	ded prerequisites fo ources in Medicine	or participation			
4	Form of exa Module exam • Modul The examin less than 20 examination	mination m: e exam (Technical ex ation takes place in students register, th a will be announced i	camination, Oral/ form of a written the examination with n the beginning o	written examination n exam (duration: ill be an oral exam f the lecture	on, Duration: 120 Min 120 minutes). If or ination (duration: 3	n., Default RS) ne can estimate that 0 min.). The type of
5	Prerequisite for the award of credit points Passing the final module examination					
6	Grading Module exa • Modul	m: e exam (Technical ex	amination, Oral/	written examinatio	on, Weighting: 100 %)
7	Usability of M.Sc. MedT	the module lec				

8	Grade bonus compliant to §25 (2)						
9	References						
	 Schardt et al. ' Heavy-ion tumor therapy: Physical and radiobiological benefits', 2010; DOI: 10.1103/RevModPhys.82.383 NuPECC: 'Nuclear Physics for Medicine', 2014, www.nupecc.org/pub/npmed2014.pdf 						
Cot	ırses						
	Course nr. 18-gr-2020-vl	Course name Ion Beam Therapy					
	Instructor Prof. DrIng. Ch	ristian Graeff	Type Lecture	SWS 2			
	Course nr. 18-gr-2020-ue	Course name Ion Beam Therapy					
	Instructor Prof. DrIng. Ch	ristian Graeff	Type Practice	SWS 1			

Mo Adv	dule name	Electronics				
Mo 18-	dule nr. gt-2010	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration	Module cycle Winter term
Lar Eng	iguage glish			Module owner Prof. DrIng. Ger	d Griepentrog	
1	 Teaching content Switch mode power supplies (insulating DC/DC-converters) Realistic behavior of power semiconductors: Basics of semiconductor physics; Behavior of diode, bipolar transistor, SCR, GTO, MOSDFET and IGBT, Importancircuits for switching real semiconductors with low losses Thermal design and thermo mechanical aging of power electronics systems Reliability of Power electronic systems Forced commutation of SCRs, Loss reducing snubbers, quasi- resonant circuits, resonant switching. 					
2	Learning of Upon succes	ojectives sful completion of th	ne module, studen	ts will be able to:		
	 Explain und understand the cross sectional layers and the basic modes of operation for power semiconductors (diode, thyristor, GTO. Mosfet and IGBT). Describe the steady state and dynamic behavior of these devices. Identify the circuit diagrams for isolating DC/DC converters, especially for use in switched mode power supplies. Calculate the currents and voltages in these circuits using defined simplifications. Describe the functions of gate dive-circuits for ITGBTs. Calculate the thermal behavior and design the cooling equipment for a voltage source inverter equipped with IGBT modules. Describe the stress reliving circuits to reduce switching losses in IGBTs. Calculate the current and voltage characteristics in quasi-resonant and resonant circuits used in power electronics. Explain multilevel converters such as 3L-NPC and MMC Know the main concepts for cooling of power electronics incl. the ability to design a cooling concept and should know main aspects which influence lifetime 					
3	Recommend BSc ETiT or	ded prerequisites fo equivalent, especiall	or participation y Power Electroni	cs and Basics of Ser	miconductors	
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS))
5	Prerequisite Passing the f	e for the award of c final module examina	redit points ation			
6	Grading Module exar • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, B.Sc. und M.S	Sc. iST	
8	Grade bonu	s compliant to §25	(2)			
9	References					

Script available in Moodle for download Literature:

- Schröder, D.: "Leistungselektronische Schaltungen", Springer-Verlag, 1997
- Mohan, Undeland, Robbins: Power Electronics: Converters, Applications and Design; John Wiley Verlag; New York; 2003
- Luo, Ye: "Power Electronics, Advanced Conversion Technologies", Taylor and Francis, 2010

Courses Course nr. **Course name** 18-gt-2010-vl Advanced Power Electronics Instructor Туре SWS Prof. Dr.-Ing. Gerd Griepentrog Lecture 2 Course nr. Course name 18-gt-2010-ue Advanced Power Electronics Туре SWS Instructor Prof. Dr.-Ing. Gerd Griepentrog Practice 2

Mo	dule name					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	gt-2020	5 CP	150 h	90 h	1 Term	Summer term
Lar	nguage			Module owner		
Eng	glish			Prof. DrIng. Ger	d Griepentrog	
1	1 Teaching content Control structures for drives; Design of controllers for drives; VSIs for drives; Space Vectors as basis of modelling AC-machines; Reference frames for description of AC-machines; Control oriented block diagram for DC-drive Structure and design of the controllers; Control oriented block diagram for Permanent Magnet Synchronous Machine (PMSM); Control oriented block diagram for Induction machine (IM) Torque control for AC-machines using linear or switching controllers. Field Oriented Control and Direct Torque Control for PMSM and IM. Models and observers for rotor flux of IM Speed control including oscillatory load. Resolver and Encoder. Problem of Motion control					
2	Learning of Upon succes	ojectives sful completion of th	ne module, studen	ts will be able to:		
	 develop the control-oriented block diagrams for the DC-machine operating in base speed range as well as in field weakening range. design the control loops for 1.) concerning the structure and the control parameters. Understand and apply space vectors and master their application in different rotating frames of reference. Develop the dynamic equations of the permanent exited synchronous machine and the induction machine and to simplify these equations by help of suitable rotating reference frames and represent these equations as non-linear control-oriented block diagram. Design the control loops according to 4.) especially the field-oriented control concerning the structure of the control loops and the control parameters. Understand the deduction of equations given in the literature for machine types, which are not discussed in this lecture, e.g. for the doubly fed induction machine. Derive the models and the observers for the rotor flux for the induction machine in different frames of reference and to apprise the benefits and drawbacks of the different solutions. Design the control loops for the super-imposed speed controls even for mechanically oscillating loads. 					
3	Recomment BSc ETiT or	ded prerequisites fo equivalent, especiall	or participation y Control Theory	and Electrical Mac	hines / Drives	
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	Grading Module exar • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	it - SAE, M.Sc. etit	- EET, M.Sc. WI-e	tit, M.Sc. CE, B.Sc. u	nd M.Sc. iST
8	Grade bonu	s compliant to §25	(2)			

9 References

Lecture notes, instructions for exercises are available in Moodle for download. Literature:

- Mohan, Ned: "Electric Drives and Machines"
- De Doncker, Rik; et. al.: "Advanced Electrical Drives"
- Schröder, Dierk: "Elektrische Antriebe Regelung von Antriebssystemen"
- Leonhard, W.: "Control of Electrical Drives"

CO	urses			
	Course nr.Course name18-gt-2020-vlControl of Drives			
	Instructor Prof. DrIng. Ger	rd Griepentrog	Type Lecture	SWS 2
	Course nr.Course name18-gt-2020-ueControl of Drives			
	Instructor M.Sc. Ivan Kliasheu, Prof. DrIng. Gerd Griepentrog		Type Practice	SWS 2

Mo Rea	dule name	rations and Commun	ication with Micro	controllers and Pro	ogrammable Logic De	evices	
Mo	dule nr.	Credit points	Workload	Self-study 75 h	Module duration	Module cycle	
Lan	iguage man		120 11	Module owner Prof. DrIng. Ger	rd Griepentrog	Every beliester	
1	German Prof. Dr. Ing. Gerd Griepentrog 1 Teaching content Microcontroller and programmable logic devices are being used for a variety of control tasks for industrial and residential products and systems. For the control of drives and power electronics, those devices are used for the control of frequency converters or DC/DC converters. In most of these applications, real time requirements have to be met. Simultaneously a communication interface has to be served. The module will impart knowledge and expertise on how to realize successfully control task. More in detail, the following content will be taught: • Architecture of microcontroller • Structure and function of FPGAs, tools and programming languages • Typical peripheral components for microcontrollers • Capture & Compare, PWM, A/D-converter • I2C, SPI, CAN, Ethernet • Programming of microcontrollers in C • Software: real-time properties, interrupt handling, interrupt latency • Control of inductive components • Basic of circuit design for power electronics, Power-MOSFETS, IGBTsNumerical methods						
2	 Learning objectives Students will be able to: Separate a digital control task into HW and SW parts Specify the HW-content in a HW description language and implement the SW by means of a microcontroller Evaluate the real-time capabilities of a program and to determine upper limits for the response time of the systemTransfer the developed solution to the target system by means of a development kit and debug the software onto the target system. 						
3	Recommen Basic knowl	ded prerequisites fo edge in programmig	or participation language C (synta	ax, operators, point	ter)		
4	Form of exa Module exa • Modu	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	120 Min., Default RS	5)	
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)						
7	Usability of M.Sc. MEC,	f the module M.Sc. ESE, M.Sc. eti	it - EET, M.Sc. WI	etit, B.Sc. und M.S	Sc. iST		
8	Grade bon	is compliant to §25	(2)				
9	References						

	Script, Instruction for practical lab courses, ppt-Slides; either in hard-copy or for download; User Manuals of the used devices and development kits								
Cot	Courses								
	Course nr. Course name 18-gt-2040-vl Real Time Applications and Communication with Microcontrollers and programmal Logic Devices								
	Instructor Prof. DrIng. Ger	rd Griepentrog	Type Lecture	SWS 1					
	Course nr. 18-gt-2040-pr	Course name Real Time Applications and Communication with Microcon Logic Devices	trollers and programma	ible					
	Instructor Prof. DrIng. Chi	ristian Hochberger, Prof. DrIng. Gerd Griepentrog	Type Lab	SWS 2					

Mo Art	dule name ificial Intellige	ence in Medicine				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Ger	nguage man	0.01	100 11	Module owner Prof. DrIng. Chr	istoph Hoog Antink	whiter term
1	Teaching co	ontent				
	 Introd Data a Featur Statist Classif L S Classifi L S Overfii Influer Evalua "Expla Regula 	uction, terms and def equisition and prepro- e extraction and visu- ical fundamentals fication methods inear Regression, Log upport Vector Machin Decision Trees, Rando Jeural Networks tting and underfitting and underfitting ince of unbalanced da attion of algorithms inable AI"	limitations ocessing alization methods gistic Regression nes om Forest, XGBoos g with medical day ta sets	s tt ta		
2	Learning ol Students ha context. Th have an ove examples fro gene sequen to gender ra future profe evaluation, medical soft	ojectives we a basic understan ey have learned how rview of current proc om various subfields cing, etc. Students un tio) data sets in a me essional activities in are familiar with the ware. They are able	nding of the term v features can be cedures and know of medical techno nderstand the dan edical context. Th relation to Fair A concept of "Expla to independently	inology of Artificia extracted from me how they work. T logy, e.g. signal pr gers of underfitting ey are aware of the I. Students have a ainable AI" and kno develop AI-based s	al Intelligence, espece edical data and visua hey are familiar with ocessing, image proce t, overfitting, and imb e social and ethical re n advanced underst ow the basic regulate olutions to medical to	cially in the medical alized. The students in current application ressing, spectroscopy, balanced (e.g. related esponsibility of their anding of algorithm ory requirements for echnology problems.
3	Recommen 18-zo-1030	ded prerequisites fo Fundamentals of Sig	or participation nal Processing			
4	Form of exa Module exam • Modul The examin than 21 stud	amination m: e exam (Technical ex ation takes place in f lents register, the exa	kamination, Oral/ form of a written amination will be	written examinatio exam (duration: 9 an oral examinatio	n, Duration: 90 Min. 0 minutes). If one ca n (duration: 20 min.	., Default RS) an estimate that less).
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exan • Modul	m: e exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %))
7	Usability of M.Sc. MedT	the module ec, B.Sc. und M.Sc. i	ST			
8	Grade bonu	is compliant to §25	(2)			

By participating in online tests, a bonus can be acquired for the exam. The following key applies "points achieved at the end of the semester" -> "grade improvement": 60% -> 0.1; 65% -> 0.2; 70% -> 0.3; 75% -> 0.4; >=80% -> 0.5. The bonus is converted into raw points, i.e. a bonus of 0.5 corresponds to half the points of a whole grade step (e.g. 3.0 to 2.0). Exam Bmust be passed without a bonus to receive the bonus. The total score is the points achieved + bonus points and is rounded."

9 References

- Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. The elements of statistical learning. Vol. 1. No. 10. New York: Springer series in statistics, 2001.
- Bishop, Christopher M. Pattern recognition and machine learning. Springer, 2006.

CO	urses			
	Course nr. 18-ha-2020-vl	Course name Artificial Intelligence in Medicine		
	Instructor Prof. DrIng. Chi	ristoph Hoog Antink	Type Lecture	SWS 2
	Course nr. 18-ha-2020-ue	Course name Artificial Intelligence in Medicine		
	Instructor Prof. DrIng. Chi	ristoph Hoog Antink	Type Practice	SWS 1
	Course nr. 18-ha-2020-pr	Course name Artificial Intelligence in Medicine		
	Instructor Prof. DrIng. Chr	ristoph Hoog Antink	Type Lab	SWS 1

Mo Lov	dule name v-Level Synthe	esis						
Mo	dule nr. hb-2010	Credit points	Workload	Self-studyModule durationModule cycle120 h1 TermSummer term				
Lan Eng	Language Module owner English Prof. DrIng. Christian Hochberger							
1	Teaching content The module deals with synthesis steps on all abstraction layers below the register transfer level focusing on approaches suitable for FPGAs. At the logic level different types of minimization are explained (exact and heuristic two level minimizations, exact and heuristic multi level logic minimizations). The transition to the technology level is achieved by different decomposition and structural mapping techniques (FlowMap). Place&Route add geometric information to the technology mapped circuit. Analytical and heuristic placers are discussed (Simulated Annealing, Genetic Placers) and routing is illustrated through the PathFinder algorithm							
2	 Learning objectives After completion of the module, students are enabled to investigate synthesis approaches for low level synthesis tasks. They can evaluate these approaches regarding their time and space complexity, as well as regarding their applicability to specific implementation technologies. Students can apply these approaches to new architectures and technologies. 							
3	Recommended prerequisites for participation Knowledge of hardware synthesis on the basis of at least one hardware description language is required (e.g. Reese/Thornton: Introduction to Logic Synthesis Using Verilog Hdl oder Brown/Vranesic: Fundamentals of Digital Logic with VHDL Design). The student should have basic knowledge of at least one object oriented programming language preferably Java							
4	Form of exa Module exar • Module	mination n: e exam (Technical e:	xamination, Oral e	examination, Durat	ion: 30 Min., Defau	lt RS)		
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Technical e	xamination, Oral 6	examination, Weigl	nting: 100 %)			
7	Usability of M.Sc. etit - I	the module DT, M.Sc. WI-etit, M	.Sc. iCE, B.Sc. und	ł M.Sc. iST				
8	Grade bonu	s compliant to §25	(2)					
9	References The slides of	the lecture will be o	listributed throug	h moodle.				
COL	urses							
	Course nr. 18-hb-2010-	Course namevlLow-Level Syr	nthesis					
	Instructor Prof. DrIng	Christian Hochberg	ger		Type Lecture		SWS 2	

	Course nr. 18-hb-2010-pr	Course name Low-Level Synthesis		
	Instructor Prof. DrIng. Chr	istian Hochberger	Type Lab	SWS 2

Mo Hio	dule name	esis					
Mo	Module nr. Credit points Workload Self-study Module duration Module cycle 18 bb 2020 6 CP 180 b 120 b 1 Torm Winter torm						cle
18-	hb-2020	6 CP	180 h	120 h	1 Term	Winter terr	n
Eng	l guage lish			Prof. DrIng. Chi	ristian Hochberger		
1	 Teaching content Mapping of behavioral descriptions (e.g. in the form of program fragments) on FPGA and CGRA structures Sub-tasks allocation, scheduling, binding Exact or heuristic solutions Design principles of heuristic solutions 						
2	Learning objectives Students that have completed this module know alternative approaches for all of the tasks of the high level synthesis and can select appropriate ones for specific applications. They can evaluate the memory and time complexity of the given algorithms. They are enabled to adapt the algorithms for new constraints and new target technologies.						
3	Recommend Knowledge of Reese/Thorr Digital Logic programmin	led prerequisites for of hardware synthes nton: Introduction t with VHDL Desigr g language, preferal	or participation is on the basis of a o Logic Synthesis n). The student sh oly Java	at least one hardw Using Verilog Hdl hould have basic k	are description lan oder Brown/Vran nowledge of at lea	guage is requin esic: Fundame st one object c	red (e.g. ntals of priented
4	Form of exa Module exan • Module	mination n: e exam (Technical e:	xamination, Oral 6	examination, Durat	ion: 30 Min., Defa	ılt RS)	
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical e:	xamination, Oral e	examination, Weigl	nting: 100 %)		
7	Usability of M.Sc. etit - I	the module DT, M.Sc. WI-etit, M	.Sc. iCE, B.Sc. und	l M.Sc. iST			
8	Grade bonu	s compliant to §25	(2)				
9	References English slide	s can be obtained th	rough Moodle.				
Coi	ırses						
	Course nr. 18-hb-2020-	vl High-Level Sy	nthesis				
	Instructor Prof. DrIng.	Christian Hochberg	ger		Type Lecture		SWS 2
	Course nr. 18-hb-2020-j	pr High-Level Sy	nthesis				
	Instructor Prof. DrIng.	Christian Hochberg	ger		Type Lab		SWS 2

Mo	dule name	ie II					
Mo	Module nr. Credit points Workload Self-study Module duration Module cycle						cle
18-	18-hb-2030 6 CP 180 h 120 h 1 ferm Summer te					rm	
Ger	man			Prof. DrIng. Chi	ristian Hochberger		
1	Teaching co	ntent					
	 Configurable Technologies FPGA architectures and properties System-On-Chip, HW components, SW toolchain, support SW Coarse grained reconfigurable architectures, PE architecture, Modulo schedu-ling 						
2	Learning objectives After completion of the module, students know reconfigurable technologies as well as chip architecture that employ them (e.g. FPGAs and CGRAs). They can select an ap-propriate technology for a given specific application. They know the components a system-on-chip (SoC) consists of. Students can configure and program an application specific SoC. They can map simple applications to a CGRA and know the limitations and pitfalls of this mapping.						
3	Recommend Thorough ba "Logischer En the program	led prerequisites for asic knowledge of di ntwurf" and "Rechne ming language C.	or participation igital circuits and ersysteme I". Addit	computer achitect tionally, stu-dents s	ture. as can be ob-ta hould be able to writ	ained in the l e simple prog	ectures rams in
4	Form of exa Module exan • Module	mination n: e exam (Technical ez	xamination, Oral 6	examination, Durat	ion: 30 Min., Defaul	t RS)	
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical ez	xamination, Oral 6	examination, Weigl	nting: 100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	c. etit - SAE, M.Sc	. WI-etit, M.Sc. CE	, M.Sc. iCE, M.Sc. iS	Т	
8	Grade bonu	s compliant to §25	(2)				
9	References The slides (in	n German) of the lec	ture can be obtain	ned through moodl	e.		
Coi	ırses						
	Course nr. 18-hb-2030-	vl Course name Computer Syst	tems II				
	Instructor M.Sc. Ramor	n Wirsch, Prof. DrIr	ıg. Christian Hoch	ıberger	Type Lecture		SWS 3
	Course nr. 18-hb-2030-	ue Computer Syst	tems II				
	Instructor M.Sc. Ramor	n Wirsch, Prof. DrIr	ng. Christian Hoch	ıberger	Type Practice		SWS 1
Mo Adv	dule name vanced Digita	l Integrated Circuit D	Design				
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Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	ho-2010	6 CP	180 h	120 h Module owner	1 Ierm	Winter term	
Eng	glish			Prof. DrIng. Kla	us Hofmann		
1	1 Teaching content MOS Transistor Models, CMOS Logic Gates, Chip Layout and Design Rules, Static and Dynamic Behavior of CMOS Circuits, Synchonous CMOS Circuits, Performance and Power Characterisation, Design Techniques and CAD Tools, FPGA and Gate Array Technologies, Memory Technologies, Data-Converters (A/D, D/A), Chip Test.						
2	 2 Learning objectives A student is, after successful completion of this module, able to understand the short-channel effects of modern CMOS transistors, derive and analyse the most important circuit concepts for digital logic gates, understand the design flow of digital ASICs based on standard cells (design, layout, simulation/verification), know the pros and cons of synchronous vs. asynchronous logic, multiclockphase systems, understand the differential design methods of integrated circuits (ASIC, ASIP, Full-custom/Semicustom, PLA, PLD, FPGA), understand basic circuitry of logic and arithmetic units (adders, multipliers, PLL/DLL), understand the concepts of A/D and D/A-converters, and their fundamental technical properties and architectures, know the design principles and properties of integrated semiconductor memory (DRAM, SRAM, Flash. MRAM, FeRAM) 						
3	Recomment Lecture "Ele	ded prerequisites fo ctronics"	or participation				
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)		
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	Grading Module exan • Modul	m: le exam (Technical ex	amination, Exam	ination, Weighting:	100 %)		
7	Usability of M.Sc. etit - I	the module DT, M.Sc. etit - SAE,	M.Sc. WI-etit, M.S	Sc. iCE, M.Sc. iST			
8	Grade bonu A grade imp	is compliant to §25 provement of up to 1,	(2) 0 due to a bonus i	s possible, which c	an be earned with te	sts.	
9	 A grade improvement of up to 1,0 due to a bonus is possible, which can be earned with tests. 9 References Lecture Slide Copies John P. Uyemura: Fundamentals of MOS Digital Integrated Circuits Neil Weste et al.: Principles of CMOS VLSI Design 						
	11303						

Course nr. 18-ho-2010-vl	Course name Advanced Digital Integrated Circuit Design		
Instructor Prof. DrIng. Kla	Type Lecture	SWS 3	
Course nr. 18-ho-2010-ue	Course name Advanced Digital Integrated Circuit Design		·
Instructor Prof. DrIng. Kla	us Hofmann	Type Practice	SWS 1

Mo Mic	dule name	Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar	nguage		120 11	Module owner Prof. DrIng. Kla	us Hofmann	Summer term
1	Teaching co Microproces	ontent ssor Architectures, DS	SP Architectures a	nd Hardware relat	ed Programming	
2	2 Learning objectives Upon successful completion of the module, students will be able to:					
	 gain the overview on the fundamentals of computer architecture and the different processor classes (RISC, CISC, Mikrocontroller, CPU, DSP), understand the central building blocks of a CPU understand the major properties of the required semiconductor memories, I/O blocks and data busses (USB, PCI, RS232), understand the most commonly used Interrupt- and Trap-handling algorithms, know the common software development methodologies for microcontrollers (assembler, pseudooperations, makros, subprograms and subroutines), understand the most important fundamentals of hardware oriented programming using C. 					
3	Recommended prerequisites for participationBasics of Computer Architectures					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) 					
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exan • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	c. iCE, B.Sc. und M	M.Sc. iST		
8	8 Grade bonus compliant to §25 (2) During the semester, a maximum grade improvement of 1.0 can be achieved. The grade improvement has no influence on passing the final module examination. Bonus points are awarded for the successful completion of tests. The points achieved in the bonus system are converted linearly into exam points, with 50% of the achievable bonus points 0 exam points are added accordingly, from 95% of the achievable bonus points exam points are added for a grade improvement of 1.0. Bonus points are scored from a maximum of three tests, each of which must be on a different topic. Several tests can be offered for each topic; tests can also be offered for more than three topics. The exact bonus system will be presented at the beginning of the course. The aim of the bonus system is to be able to test the programming of microcontrollers in a more practical way.					
9	References Slide Copies	3				
Coi	Courses					

Course nr. 18-ho-2040-vl	Course name Microprocessor Systems		
Instructor M.Sc. Dirk Leiac	ker, DrIng. Matthias Rychetsky	Type Lecture	SWS 2
Course nr. 18-ho-2040-ue	Course name Microprocessor Systems		
Instructor M.Sc. Dirk Leiac	ker, DrIng. Matthias Rychetsky	Type Practice	SWS 1

Mo Cor	dule name nputer Aided	Design for SoCs						
Mo 18-	dule nr. ho-2200	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module du 1 Term	iration	Module cyc Summer ter	c le rm
Lan Eng	LanguageModule ownerEnglishProf. DrIng. Klaus Hofmann							
1	Teaching co CAD-Concep	ntent ots for the design and	l simulation of int	egrated system-on-	chips			
2	 2 Learning objectives A student is, after successful completion of this module, able to understand the most important design and verification abstractions as well as the design flow for the design of integrated electronic systems, selected algorithms for optimization, simulation and solving of design tasks, advanced methods for the design and simulation of analog integrated circuits in modern CMOS technologies, advanced concepts of hardware description languages and their concepts (Verilog, VHDL, Verilog-A, Verilog-AMS, System-Verilog) 							
3	Recommended prerequisites for participation Lecture "Advanced Digital Integrated Circuit Design" (can be attended in parallel) and "Electronic and Integrated Circuits" and "Logic Design"							
4	Form of examination Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)							
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	c. etit - SAE, M.Sc	. WI-etit, M.Sc. CE	, M.Sc. iCE, I	B.Sc. und	l M.Sc. iST	
8	Grade bonu A grade import the embedde	s compliant to §25 rovement of up to 1, ed labs.	(2) 0 due to a bonus is	s possible, which ca	n be earned	by succes	ssful participa	ation in
9	References Slide Copies							
Coι	ırses							
	Course nr.Course name18-ho-2200-vlComputer Aided Design for SoCs							
	Instructor Prof. DrIng	. Klaus Hofmann			1 1	Гуре Lecture		SWS 2
	Course nr. 18-ho-2200-	ue Computer Aid	ed Design for SoC	s				
	Instructor Prof. DrIng	. Klaus Hofmann			1 F	Гуре Practice		SWS 1

Course nr. 18-ho-2200-pr	Course name Computer Aided Design for SoCs		
Instructor Prof. DrIng. Kla	us Hofmann	Type Lab	SWS 1

Indus Modu 18-hc Lang Germ 1 7 S F P 2 I 4 H 1 4 H	strial Electro ule nr. o-2210 yuage han/English Teaching co Typical Stru Sensor Fron Knowledge o Learning ol After success 1. unders 2. unders	nics Credit points 4 CP ontent ture of Industrial Elec- tend, Actuator Fronto of Relevant Standards ojectives sfull completion of the stand the use of elect stand the function of	Workload 120 h ctronics Compone end, Supply and F s and Technical Ra ne module, studen	Self-study 75 h Module owner Prof. DrIng. Klan ents. Characteristics Reference Level), Fu	Module duration 1 Term us Hofmann s of Typical Building unctioning of Relevan	Module cycle Winter term			
Modu 18-hc Lang Germ 1 7 5 H 2 I 3 H 1 4	ule nr. o-2210 yuage han/English Teaching co Typical Stru Sensor Fron Knowledge o Learning ol After success 1. unders 2. unders	Credit points 4 CP ontent ture of Industrial Elec- tend, Actuator Fronte of Relevant Standards ojectives sfull completion of the stand the use of elect stand the function of	Workload 120 h ctronics Compone end, Supply and F s and Technical Re ne module, studen	Self-study 75 h Module owner Prof. DrIng. Klau ents. Characteristics Reference Level), Fu	Module duration 1 Term is Hofmann of Typical Building inctioning of Relevan	Module cycle Winter term			
Lang Germ 1 7 5 F 2 I 4 H N	guage nan/English Teaching co Typical Stru Sensor Fron Knowledge o Learning ol After success 1. unders 2. unders	ontent ture of Industrial Elec- tend, Actuator Fronto of Relevant Standards ojectives sfull completion of the stand the use of elect stand the function of	ctronics Compone end, Supply and F s and Technical Re te module, studen	Module owner Prof. DrIng. Klan ents. Characteristics Reference Level), Fu egulations.	is Hofmann of Typical Building inctioning of Relevan	Blocks (Digital Core			
Germ 1 7 5 F 2 I 4 H N	nan/English Teaching co Typical Stru Sensor Fron Knowledge of Learning of After success 1. unders 2. unders	ontent ture of Industrial Elec- tend, Actuator Fronto of Relevant Standards ojectives sfull completion of th stand the use of elect stand the function of	ctronics Compone end, Supply and F s and Technical Ra ne module, studen	Prof. DrIng. Klan ents. Characteristics Reference Level), For egulations.	us Hofmann s of Typical Building unctioning of Relevan	Blocks (Digital Core			
1 7 5 F 2 I 4 H N	Teaching co Typical Stru Sensor Fron Knowledge o Learning ol After success 1. unders 2. unders	ontent ture of Industrial Elec- tend, Actuator Fronto of Relevant Standards ojectives sfull completion of the stand the use of elect stand the function of	ctronics Compone end, Supply and F s and Technical Re ne module, studen	nts. Characteristics Reference Level), Fi egulations.	of Typical Building Inctioning of Relevar	Blocks (Digital Core			
2 I 4 H N	Learning ol After success 1. unders 2. unders	ejectives Sfull completion of th Stand the use of elect Stand the function of	e module, studen		Image: Content Typical Struture of Industrial Electronics Components. Characteristics of Typical Building Blocks (Digital Core, Sensor Frontend, Actuator Frontend, Supply and Reference Level), Functioning of Relevant Field Bus Systems, Knowledge of Relevant Standards and Technical Regulations.				
3 H I 4 H	 2 Learning objectives After successfull completion of the module, students are able to: 1. understand the use of electronic components in typical industrial environments, 2. understand the function of the building blocks of typical IE comonents, 3. deeply understand the functioning of analog bulding blocks, 4. understand relevant field bus systemes, 5. understand the regulatory and technical standards of industrial electronics components. 								
4 H	Recommended prerequisites for participation Lecture "Elektronik" and "Electronic and Integrated Circuits"								
7 5 V	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 5 students register, the examination will be an oral examination (duration: 30 min.). The type of examination will be announced in the beginning of the lecture. 								
5 H H	Prerequisit Passing the f	e for the award of cr	r edit points ation						
6 (N	Grading Module exa • Modul	n: e exam (Technical ex	amination, Oral/v	written examinatio	n, Weighting: 100 %)			
7 U 1	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	. etit - SAE, M.Sc.	. WI-etit, M.Sc. etit	- AUT, M.Sc. iCE, B.	.Sc. und M.Sc. iST			
8 0	Grade bonu	s compliant to §25	(2)						
9 I	 9 References Dietmar Schmid, Gregor Häberle, Bernd Schiemann, Werner Philipp, Bernhard Grimm, Günther Buchholz, Jörg Oestreich, Oliver Gomber, Albrecht Schilling: "Fachkunde Industrieelektronik und Informationstechnik"; Verlag Europa-Lehrmittel, 11 th Ed. 2013. Gunter Wellenreuther, Dieter Zastrow; "Automatisieren mit SPS - Theorie und Praxis"; Springer Verlag, 6 th Ed. 2015. Ulrich Tietze, Christoph Schenk, Eberhard Gamm: "Halbleiter-Schaltungstechnik"; Springer Verlag, 15 th Ed. 2016. 								

Course nr. 18-ho-2210-vl	Course name Industrieelektronik		
Instructor DrIng. Roland Steck		Type Lecture	SWS 2
Course nr. 18-ho-2210-ue	Course name Industrieelektronik		
Instructor DrIng. Roland S	Steck	Type Practice	SWS 1

Mo	dule name)poration of Dowor S	upply			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	hs-2010	3 CP	90 h	60 h	1 Term	Summer term
Lar Ger	nguage man			Module owner Prof. DrIng. Jutt	a Hanson	
1	Teaching co	ontent				
	 Basic introduction to the regulation of distribution systems operators. In this context, different tasks of the grids with regard to the energy supply as well as the "Energiewende" will be addressed. Technical functions for the operation of grid supply. Functions here are asset management, system operations and metering. Excursion with on-site visit (grid control center, current project or power plants) Non-technical functions related to the operation of grid supply. These include regulatory functions such as connection management and billing, occupational safety and management of critical infrastructure. Incentive regulation as a regulatory framework for utility network operation Insights into entrepreneurial tasks and field reports 					
2	2 Learning objectives After attending the module, students will be familiar with the basic technical and non-technical functions of distribution systems operators. After a basic introduction, the course first teaches the technical tasks for the operation of supply networks. Topics here are asset management, grid operation, and metering. In the second part, the non-technical functions are taught. Here, the connection management, the occupational safety, the environmental and health protection as well as the crisis management in distribution networks play a central role. The module also provides a basic understanding of the driving factors and developments in (German) power grids with regard to the "Energiewende". In addition, students will also be familiar with the different levels of incentive regulation, from operating resources to grid charges. Last but not least, the module provides					echnical functions of chnical tasks for the tering. In the second upational safety, the works play a central pments in (German) ar with the different the module provides
3	Recommend Good knowle	ded prerequisites fo edge of content of th	r participation e lecture "Energie	technik"		
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	60 Min., Default RS)	
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Examination, Weighting: 100 %) 					
7	Usability of M.Sc. ESE, M	the module M.Sc. etit - EET, M.Sc	c. WI-etit			
8	Grade bonu	s compliant to §25	(2)			
9	References					

	A lecture notes o • Moodle Pla Additional literat • To be anno	r slides can be downloaded: tform cure: unced at the beginning of the lecture				
Co	Courses					
	Course nr.Course name18-hs-2010-vlRegulation and Operation of Power Supply					
	InstructorTypeSWSM.Sc. Felix Korff, DrIng. Andreas Berg, M.Sc. Marcel BöhringerLecture2					

Мо	dule name							
Ele	ktrische Energ	gieversorgung II / Po	wer Systems II	0.16	N. 1.1.	1	37.1.1.	.1.
Mo	dule nr. hs-2030	Credit points 5 CP	Workload 150 h	Self-study 90 h	1 Term	duration	Winter tern	cle 1
Lar	iguage			Module owner				
Ger	man/English			Prof. DrIng. Jutt	a Hanson			
1	 The lecture Power Supply II deals with the dynamic behavior of electrical power systems. For this the stationary behavior of the equipment is extended by the dynamic behavior, in order to show the resulting network behavior. With this background in-depth insights into the stability of the electrical power supply network are provided. The influence of controlled generation plants on stability is addressed. Finally, power quality is considered, which is gaining importance for steady-state and dynamic behavior with the increased use of power electronics. The following topics will be covered: Steady-state and dynamic behavior of synchronous generators and renewable generation plants (grid behavior and control of power electronic converters) Time curve of short-circuit currents and their quasi-stationary calculation Stability types (static stability, transient stability, voltage stability, frequency stability, resonance stability & inverter-driven stability) Power quality 							
2	Learning objectives After successful completion of the module, the students have a profound understanding of the different types of stability of electrical power systems. They have gained a basic understanding of dynamic network behavior and the control of generation plants, as well as power quality.							
3	Recomment Knowledge of using symm	ded prerequisites fo comparable to "Energ etrical components.	or participation ieversorgung I" or	basic knowledge of	power sys	tem equipr	nent and calcı	lations
4	Form of exa Module exa • Modul	mination n: e exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., I	Default RS)		
5	Prerequisit Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exa • Modul	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. ESE, I	the module M.Sc. etit - EET, M.S	c. WI-etit, M.Sc. C	E, B.Sc. und M.Sc.	iST			
8	Grade bonus compliant to §25 (2)							
9	References Lecture slide	es, tutorials and past	exams are availab	le via Moodle.				
Coι	ırses							
	Course nr. 18-hs-2030-	vl Elektrische En	ergieversorgung I	/ Power Systems	I			
	Instructor M.Sc. Anna	Pfendler, Prof. DrIn	g. Jutta Hanson, I	M.Sc. Soham Chou	dhury	Type Lecture		SWS 2

Course nr. 18-hs-2030-ue	Course name Elektrische Energieversorgung II / Power Systems II		
Instructor M.Sc. Anna Pfen	dler, Prof. DrIng. Jutta Hanson, M.Sc. Soham Choudhury	Type Practice	SWS 2

Mo Elel	dule name ktrische Energ	ieversorgung III / Po	ower Systems III					
Mo	dule nr. hs-2080	Credit points	Workload 90 h	Self-study 60 h	Module	duration	Module cyc	cle rm
Lan Ger	n guage man/English			Module owner Prof. DrIng. Jutta Hanson				
1	 Teaching content This lecture covers the power transmission and system analysis of transmission systems and the innovative system equipment. The following topics will be covered: 							
2	Learning objectives After successful completion of this module, the students have a profound understanding of the power system stability and analysis, know the driving forces for the utilisation of innovative equipment (HVDC,FACTS) in power systems. They understand the system behaviour and operation of this equipment and can model it and thus design it for safe and reliable operation.							
3	Recommend Contents of '	led prerequisites fo 'Power Systems I" ar	or participation nd "Power Systems	5 II"				
4	Form of exa Module exam • Module The examination than 6 stude be announce	mination n: e exam (Technical ex tion takes the form on nts will register, the d at the beginning o	xamination, Oral/ of a written exami examination will l of the course.	written examinatio nation (duration: 9 pe oral (duration: 3	n, Duratio 90 minutes 90 minutes	n: 90 Min. s). If it is fo). The type	, Default RS) preseeable that e of examinat	at fewer ion will
5	Prerequisite Passing the f	e for the award of c inal module examina	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weight	ing: 100 %)	
7	Usability of M.Sc. ESE, M	the module A.Sc. etit - EET, M.So	c. WI-etit, M.Sc. C	E				
8	Grade bonu Yes	s compliant to §25	(2)					
9	References Lecture slide	s, exercises and past	t exams are availa	ble via Moodle				
Coι	ırses							
	Course nr. 18-hs-2080-v	Course name/lElektrische En	ergieversorgung I	II / Power Systems	III			
	Instructor M.Sc. Sivuar	n Li, Prof. DrIng. Ju	itta Hanson			Type Lecture		SWS 2

Mo Pov	dule name ver Plants and	Renewable Energies	S					
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-	hs-2090	- 4 CP	120 h	75 h	1 Term		Winter tern	n
Lar Ger	iguage man			Module owner Prof. DrIng. Jutta Hanson				
1	Teaching co Forms of end Conversion i power plant Solar therma for Energy C	ontent ergy, Characteristics n thermal processes s, gas power plants, ıl technology) and fu onverting and Storir	and figures of ele (Carnot-Process), (water power plan In ther regenerative ng (Power 2 X) - E	ectricity industry, I Categorization of po nts, wind power pl energy sources (ge lectrical systems - 0	mportance ower plant ants, Use eothermal Grid Conn	e of power s - Operati of solar er energy, bio ection for j	generation - on principle o nergy (Photov mass) - Techr power plants	Energy f steam voltaics, nologies
2	 2 Learning objectives On completion of the module students were taught the following: Overview of concepts of power generation by various energy sources Comprehension of physical processes Operation principle and design of conventional and renewable power plants and storage Comprehension of electrical devices and control concepts 							
3	Recommended prerequisites for participation Basics in Electrical Engineering, Power Engineering							
4	Form of exa Module exa • Modul	mination n: e exam (Technical e:	xamination, Exam	ination, Duration:	90 Min., D)efault RS)		
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. ESE, M	the module A.Sc. etit - EET, M.Sc	c. WI-etit					
8	Grade bonu	s compliant to §25	(2)					
9	References Script							
Coi	ırses							
	Course nr. 18-hs-2090-	vl Power Plants a	and Renewable En	ergies				
	Instructor M.Sc. Aaron Manuel Schw	1 Hebing, Prof. Dr venke	Ing. Jutta Hanso	n, M.Sc. Xiong Xia	ao, M.Sc.	Type Lecture		SWS 2

Course nr. 18-hs-2090-ue	Course name Power Plants and Renewable Energies		
Instructor M.Sc. Aaron He Manuel Schwenk	bing, Prof. DrIng. Jutta Hanson, M.Sc. Xiong Xiao, M.Sc. e	Type Practice	SWS 1

Modul Power	e name Svstem Pro	otection					
Module 18-hs-2	e nr. 2120	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration	Module cycle Winter term	
Langua Germai	age		,,,,	Module owner			
1 Te Ne Pro Ha Ap	1 Teaching content Neutral point earthing Protection types in power systems • Over-current protection • Ourernt differential protection • Distance protection • Distance protection • Earth fault protection • Further types of protection • Further types of protection • Further types of protection Hardware implementation: • • Protection relays (design + testing) • Instrument transformers Application of the protection types in protection concepts for • Power system operators • Industry • Wind and solar parks Influence of the energy transition on neutral point earthing and power system protection 2 Learning objectives						
2 Le Af po the in	Learning objectives After successful completion of this module, the students understand the influence of neutral point earthing on power system protection and know the different protection types in power systems. They have on overview of their hardware implementation and understand the application and interaction of the different protection types in protection concepts.						
3 Re Co	ecomment ontents of '	led prerequisites fo "Power Systems I"	r participation				
4 Fo Mo Th 6 s wi	orm of exa odule exan • Module ne examina students re ill be anno	mination n: e exam (Technical ex ition takes place in fo egister, the examinat unced in the beginni	amination, Oral/ rm of a written ex ion will be an ora ng of the lecture.	written examinatio am (duration: 90 n l examination (dur	n, Duration: 90 Min. ninutes). If one can es ation: 30 min.). The	., Default RS) stimate that less than type of examination	
5 Pr Pa	rerequisite assing the f	e for the award of c	r edit points ation				
6 Gr Mo	rading odule exar • Module	n: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %))	
7 Us	sability of	the module					
8 Gr	rade bonu	s compliant to §25	(2)				
9 Re Pro	e ferences resentation e s	slides					

Course nr. 18-hs-2120-vl	Course name Power System Protection		
Instructor		Type Lecture	SWS 2

Mo MI	dule name MO - Commu	nication and Space-T	ime-Coding				
Mo 18-	dule nr. ja-2010	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Winter term	
Lar Eng	iguage dish	1		Module owner Prof. DrIng. Vahid Kooshkghazi			
1	 Teaching content This lecture course introduces the principles of space-time and multiple-input multiple-output (MIMO) communications. Outline: Motivation and background; overview of space-time and MIMO communications; fading MIMO channel models, MIMO information theory, receive and transmit diversity; channel estimation, MIMO detectors, Alamouti space-time block code, orthogonal space-time block codes; linear dispersion codes; coherent and non-coherent decoders, differential space-time block coding; MIMO with limited feedback, Multiantenna- and multiuser diversity, BER performance analysis, MIMO in moden wireless communication networks, multicell and multiuser MIMO (coordinated multipoint). Learning objectives 						
2	Learning ol Students wi	bjectives ll understand modern	n MIMO communi	ications and existin	g space-time coding	techniques.	
3	Recommen Knowledge	ded prerequisites for of basic communicati	or participation on theory and bas	sic information the	ory.		
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS) The examination takes place in form of a written exam (duration: 120 minutes). If one can estimate that less than 10 students register, the examination will be an oral examination (duration: 20 min.). The type of examination will be announced in the beginning of the lecture. 						
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	Grading Module exa • Modul	m: le exam (Technical ex	amination, Oral∕	written examinatio	on, Weighting: 100 %	5)	
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	etit - KTS, M.Sc.	iCE, B.Sc. und M.S	c. iST, M.Sc. etit - VA	AS	
8	Grade bonu	is compliant to §25	(2)				
9	 Grade bonus compliant to §25 (2) References A.B.Gershman and N.D.Sidiropoulos, Editors, Space-Time Processing for MIMO Communications, Wiley and Sons, 2005. E.G.Larsson and P.Stoica, Space-Time Block Coding for Wireless Communications, Cambridge University Press, 2003; A.Paulraj, R.Nabar, and D.Gore, Introduction to Space-Time Wireless Communications, Cambridge University Press, 2003. Lin Bai and Jinho Choi, Low Complexity MIMO detectors, Springer, 2012. Howard Huang, Constantinos B. Papadias, and Sivarama Venkatesan, MIMO Communication for Cellular Networks, Springer, 2012. 						
CO	urses						

Course nr. 18-ja-2010-vl	Course name MIMO - Communication and Space-Time-Coding		
Instructor		Type	SWS
Prof. DrIng. Vahid Kooshkghazi		Lecture	2
Course nr. 18-ja-2010-ue	Course name MIMO - Communication and Space-Time-Coding		
Instructor		Type	SWS
Prof. DrIng. Vahid Kooshkghazi		Practice	1

Mo Syr	dule name	ılar Communication				
Mo 18-	dule nr. ja-2020	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Summer term
Lar Eng	iguage glish	1		Module owner Prof. DrIng. Vahid Kooshkahazi		
 Teaching content This lecture course introduces the basic principles in modeling, design, and analysis of synthetic molec communication (MC) systems. The course covers the following topics: Basic principles of synthetic MC systems and potential application scenarios Background concepts from biology and chemistry needed to understand MCs Mathematical modeling of MC channels involving advection-reaction-diffusion processes Design of modulation and detection schemes for synthetic MC systems Channel estimation and parameter estimation for synthetic MC systems Review of several experimental MC systems, their practical implementation considerations, and the sign processing of the measurement data Learning objectives 					synthetic molecular esses ations, and the signal	
 2 Learning objectives After completion of this interdisciplinary lecture, students will be able to explain the basic principles of MCs and differentiate them with respect to conventional electromage based communications explain basic related concepts from chemistry and biology such as chemical reactions, molecules, procommunication within and between cells, etc. apply the relevant physical/chemical laws (e.g., Fick's law or in general advection-reaction-differentiate in the several modulation schemes for embedding information into the properties of molecules and coptimal and suboptimal detection for recovering information derive estimators for estimating the MC channel impulse response or physical parameters of the channel name several state-of-the-art implementations of synthetic MCs and explain the tures/limitations/challenges of building MC systems, in practice The students will deepen their knowledge of the fundamentals of communication systems by reflecting on "re-learning" the entire communication blocks (e.g., modulation detection estimation etc.) in the new context of the students will deepen their knowledge of the fundamentals of communication systems by reflecting of "re-learning" the entire communication blocks (e.g., modulation detection estimation etc.) in the new context of the students will deepen their knowledge of the fundamentals of communication systems by reflecting of "re-learning" the entire communication blocks (e.g., modulation detection estimation etc.) in the new context of the students of the students will be entire communication blocks (e.g., modulation detection estimation etc.) in the new context of the students will be performed as the students will be performed as the students of communication blocks (e.g., modulation detection estimation etc.) in the new context of the students will be the students will be performed as the students of communication blocks (e.g., modulation detection estimation etc				onal electromagnetic- , molecules, proteins, on-reaction-diffusion molecules and derive trameters of the MC explain the fea- by reflecting on and .) in the new context		
3	Recomment Knowledge	ded prerequisites fo of basic communicati	or participation on theory and dig	ital communication	1	
4	Form of exa Module exa • Modul The examin less than 10 examination	amination m: le exam (Technical ex ation takes place in) students register, th n will be announced i	amination, Oral/ form of a written te examination wi n the beginning o	written examinatio n exam (duration: ill be an oral exam f the lecture.	n, Duration: 120 Min 120 minutes). If or ination (duration: 24	n., Default RS) ne can estimate that 0 min.). The type of
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exan • Modul	m: le exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %))
7	Usability of M.Sc. etit -	the module DT, M.Sc. WI-etit, M.	Sc. etit - KTS, M.S	Sc. MedTec, M.Sc.	iCE, B.Sc. und M.Sc.	iST, M.Sc. etit - VAS

8	Grade bonus co Grade improvem bonus exercises	mpliant to §25 (2) ents up to 0.4 according to APB 25(2) through bonus for reg	ularly completed and	submitted		
9	 References A lecture notes or slides can be downloaded: Moodle Platform Supplementary and advanced literature: T. Nakano, A. Eckford, and T. Haraguchi. Molecular Communications, Cambridge University Press, 2013 T. Nakano, A. Eckford, and T. Haraguchi. Molecular Communications, Cambridge University Press, 2013 P. Nelson. Biological Physics - Energy, Information, Life, Freeman and Company, 2004. 					
Co	urses					
	Course nr. 18-ja-2020-vl	Course name Synthetic Molecular Communication				
	Instructor Prof. DrIng. Vahid Kooshkghazi		Type Lecture	SWS 2		
	Course nr. 18-ja-2020-ue	Course name Synthetic Molecular Communication				
	Instructor Prof. DrIng. Val	nid Kooshkghazi	Type Practice	SWS 1		

Mo	dule name	laptive Beamforming				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	jk-2020	6 CP	180 h	120 h	1 Term	Winter term
Eng	glish			Prof. DrIng. Rol	f Jakoby	
1	 1 Teaching content Overview of most important antenna parameters types as well as their applications. Fundamental theories: Fourier transform for far-field pattern calculations, antenna modeling techniques, antenna synthesis methods, image theory, determination of field regions of line sources, of the average radiated power density and power, directivity and gain. Antennas as key elements in power budgets of radio links, introducing the effective aperture of an antenna, deriving the relation between gain and effective aperture. Array antennas are a key hardware for beamforming and smart antenna systems: fundamentals of phased-scanning arrays, non-uniformly excited, equally spaced linear arrays, multi-dimensional planar arrays and mutual coupling effects. Wire antennas: still the most prevalent of all antenna forms, relatively simple in concept, easy to construct, very inexpensive. Antenna radiation fields and antenna parameters for different types of antennas are derived from Maxwell 's equations, applied for aperture antennas (horns, lenses or reflector antennas) and printed antennas (microstrip-patch and coplanar-slot antennas) Some basic numerical calculation methods: integral equation methods in the time and frequency domain, physical optics and uniform theory of diffraction are briefly summarized and compared for antennas and scattering problems. Smart antennas in communication and radar systems, with focus on beam steering and adaptive beamforming. 					
2	2 Learning objectives Students will know basic antenna parameters: pattern, gain, directivity, half-power beamwidth, side- lobe-level efficiency and input impedance to compare, assess and evaluate different antennas for various applications and operating frequencies. The antenna field regions, reactive near-field, near-field and far-field, can be differentiated and the far-field pattern of an antenna can be determined from given current distributions along the antenna by using Fourier transformation or integral solutions with distributed ideal dipoles as basic elements (antenna analysis). To assess in general physical requirements, constrains and limitations of antennas, students can use fundamental antenna theory: impedance matching techniques, antenna modeling and far-field pattern analysis, antenna synthesis, image theory and fundamental limits of electrically small antennas. After being incorporated into the different adaptive beamforming techniques, the array theory enables the student to design antenna systems that are assembled of a certain number of separate elements, feeding network, beamforming network tec. for phased-scanning or smart antennas in communications and sensing. Moreover, students are able to determine, analyze and evaluate the most important classes of antennas in wireless technology for many applications, operating frequencies, desired requirements or practical constrains: (1.) wire- dipole antennas (2.) planar antennas, Cassegrain and Gregorian double-reflector configurations), (4.) broadband and frequency-independent antennas (V antennas, biconical antennas, helical antennas, spiral and log-periodic					idth, side- lobe-level, ious applications and can be differentiated as along the antenna c elements (antenna ennas, students can and far-field pattern ntennas. After being the student to design twork, beamforming preover, students are technology for many ire- dipole antennas, antennas, parabolic ons), (4.) broadband piral and log-periodic
3	Recomment Fundamenta	ded prerequisites fo als of Communication	or participation as, Microwave Eng	ineering 1		
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the	e for the award of cr final module examina	redit points			
6	Grading					

	Module exam: • Module exa	Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)					
7	Usability of the M.Sc. etit - SAE,	Usability of the module M.Sc. etit - SAE, M.Sc. WI-etit, M.Sc. CE, M.Sc. etit - KTS, M.Sc. iCE, B.Sc. und M.Sc. iST, B.Sc. WI-etit					
8	Grade bonus co	Grade bonus compliant to §25 (2)					
9	References Skriptum "Antennas and Adaptive Beamforming" will be provided electronically at the beginning of the lecture.						
Co	urses						
	Course nr. 18-jk-2020-vl	Course name Antennas and Adaptive Beamforming					
	Instructor DrIng. Martin S	chüßler, DrIng. Alejandro Sáez, M.Sc. Jesús Pastor	Type Lecture	SWS 3			
	Course nr. 18-jk-2020-ue	Course name Antennas and Adaptive Beamforming					
	Instructor DrIng. Martin S	InstructorTypeSWSDrIng. Martin Schüßler, DrIng. Alejandro Sáez, M.Sc. Jesús PastorPractice1					

Mo Rac	dule name lar Technique	S						
Mo 18-	dule nr. jk-2040	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module of 1 Term	luration	Module cyc Winter tern	cle n
Lar Ger	nguage man			Module owner Prof. DrIng. Rolf Jakoby				
1	Teaching co First, there v applications will be dealt detail, include	will be an introduction and the operating from with. In the second ding specific techniq	on of different rad equency ranges. Ir part, various prin ues of radar signa	ar techniques, desc a historical survey nary and secondar l processing and -a	ribing their , the radar y radar tec nalysis.	r concepts ranges and hniques w	and principle d propagation ill be investig	es, their 1 effects gated in
2	Learning of Students wil and range of processing.	ojectives l know about concep f objects. They lear They will understand	ts and principles t n about the funct l the major physic	to detect objects as tional principles of al propagation effe	well as to of various ra ects.	determine adar syster	the angular I ms, including	position g signal
3	Recommended prerequisites for participation Fundamentals of Communications, Microwave Engineering I							
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Technical e:	xamination, Oral e	examination, Weigl	nting: 100	%)		
7	Usability of M.Sc. WI-eti	the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E, B.Sc. und M.Sc.	iST, B.Sc.	WI-etit		
8	Grade bonu	s compliant to §25	(2)					
9	References Slides, Lates	t Publications and B	ooks					
Co	urses							
	Course nr. 18-jk-2040-v	Course name vl Radar Techniq	ues					
	Instructor Prof. DrIng	InstructorTypeSWSProf. DrIng. Rolf Jakoby, DrIng. Alejandro SáezLecture2						

Мо	Module name							
Mic	rowaves in Bio	omedical Application	ns				1	
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
18-	K-2110	0 CP	180 II	120 Il Modulo ownor	1 Ierm		winter tern	<u>1</u>
German Prof. DrIng. Rolf Jakoby								
1	1 Teaching content Electromagnetic properties of technical and biological materials on the microscopic and macroscopic level, polarization mechanisms in dielectrics and their applications, interaction between electromagnetic waves and biological tissue; passive microwave circuits with lumped elements (RLC-circuits) and their graphical representation in a smith chart, impedance matching; theory and applications of transmission lines, scattering- matrix formulation of microwave networks (S-parameters) and their characterization based on s-parameters; microwave components for medical applications, biological effects of electromagnetic fields, microwave-based tissue characterization and mimicking of biological tissue dielectric properties (phantoms); heat transfer in tissue from electromagetic fields, microwave systems for diagnosis and therapy, e.g., radar-based vital signs monitoring and microwave ablation of cancer.							
2	2 Learning objectives Students are able to understand basic fundamentals of microwave engineering and their application for biomedical applications. The interaction between electromagnetic waves with dielectric and biological materials are known. The students master the mathematical basis of passvie RF-circuits and their graphical representation in a smith chart. They are able to apply the transmission line theory to fundamental applications. They can characterize microwave networks in s-parameter representations. The functionality and application of RF-components for biomedicine are known. Students understand the biological effects of electromagnetic fields and are able to derive diagnestic and therapeutic applications					medical known. a smith acterize ents for able to		
3	Recommend Fundamental	ed prerequisites for s of electrical engin	or participation eering					
4	Form of exam Module exam • Module	mination 1: 2 exam (Technical ez	xamination, Exam	ination, Duration:	90 Min., D	efault RS)		
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exam • Module	n: e exam (Technical ez	xamination, Exam	ination, Weighting	: 100 %)			
7	7 Usability of the module M.Sc. WI-etit, M.Sc. MedTec							
8	8 Grade bonus compliant to §25 (2)							
9	9 References The script is provided and a list with recommended literature is presented in the lecture.							
Cot	ırses							
	Course nr. 18-jk-2110-v	Course name Microwaves in	Biomedical Appli	cations				
	Instructor Prof. DrIng.	Rolf Jakoby. DrIng	g. Martin Schüßler			Type Lecture		SWS 3

Course nr. 18-jk-2110-ue	Course name Microwaves in Biomedical Applications		
Instructor Prof. DrIng. Rol	f Jakoby, DrIng. Martin Schüßler	Type Practice	SWS 1

Mo Mic	dule name rrowave Engir	neering II					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
Lar	iguage	0.01	100 11	Module owner	1 101111	whiter term	
Eng	glish			Prof. DrIng. Roli	f Jakoby		
1	 Teaching content Part 1 Passive microwave components: Calculation of the two-port parameters of simple passive components and circuits (transmission lines and lumped elements) for MMICs Wave parameters and S-parameters Smith chart and matching circuits with line elements or lumped elements Design and equivalent circuits of passive microwave components (transmission lines, capacitors, inductors and resistors) Part 2 Active microwave components: Design and equivalent circuits of field effect transistors (FET) and heterostructure transistors (HEMTs) Gain and cut-off frequencies Schottky contacts: function and characteristics Part 3 Active microwave circuits (main part): FET amplifiers: operation, equivalent circuit, gain, matching circuit, stability and circuit implementation Oscillator design Mixer design Material choice (compound semiconductor material systems: properties, fabrication and requirements) Applications of these circuits range from communication systems such as cell phones to satellite transceivers as well as high-frequency sources up to Terahertz. 						
2	Learning ol After success microwave o	ojectives sful completion of the components (passive	module students and active) as we	understand the phy ll as microwave circ	rsics of microwave wa cuits.	veguides, resonators,	
3	Recomment Introduction	ded prerequisites fo to Electrodynamics,	or participation Microwave Engin	eering I			
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)		
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	 Grading Module exam: Module exam (Technical examination, Examination, Weighting: 100 %) 						
7	 7 Usability of the module M.Sc. WI-etit, M.Sc. CE, M.Sc. etit - KTS, M.Sc. iCE, B.Sc. und M.Sc. iST 						
8	Grade bonus compliant to §25 (2)						
9	References Script and s	lides will be handed	out. Literature wi	ll be recommended	in the lecture.		
Co ι	Courses						

Course nr. 18-jk-2130-vl	Course name Microwave Engineering II		
Instructor PD DrIng. Oktay Yilmazoglu		Type Lecture	SWS 3
Course nr. 18-jk-2130-ue	Course name Microwave Engineering II		
Instructor PD DrIng. Okta	y Yilmazoglu	Type Practice	SWS 1

Mo Hig	Module name High Voltage Technology II							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lan	nguage	- Gr	120 11	Module owner				
1	Teaching co Liquid diele random vari	ontent ctrics, solid dielectric able, arcing and arc	cs, partial dischar extinction	ges, ageing of insu	lating materials, ins	ulating capacity as a		
2	2 Learning objectives After successful completion of the module, the students are able to optimize insulation systems by choice of the dielectrics, by capacitive, refractive or resistive internal grading systems or by external geometrical/capacitive grading elements; they have understood why equipment is designed as it is and how and where it can or has to be optimized if requirements from service are changing; they have understood the physical phenomena behind the dielectric breakdown of gases and do know which are the main influencing parameters; they know the effect of strongly inhomogeneous electrode configurations and of extremely large gaps; they know the time dependencies of a dielectric breakdown and their impact on dielectric strength under impulse voltage stress; they are able to identify critical surface discharge configurations, know about the problems under severe external pollution of insulators and how to solve them; they are thus qualified to predict the dielectric strength of any electrode configuration under any kind of voltage stress and to design a particular required dielectric strength of equipment; they are particularly enabled to realize the demands of emerging UHV systems and to manage them; they have understood the mechanism of thunderstorms and lightning flashes and are able to derive protective measures for buildings, substations and overhead lines; they are skilled to calculate travelling wave effects and their effect on fast-front overvoltages and to develop adequate countermeasures.							
3	Recommen High Voltage	ded prerequisites fo e Technology I	or participation					
4	Form of exa Module exan • Modul The examin less than 21 examination	mination n: e exam (Technical ex ation takes place in students register, th will be announced i	kamination, Oral/ form of a written he examination with n the beginning o	written examinatio 1 exam (duration: ill be an oral exam f the lecture.	n, Duration: 120 Mir 120 minutes). If or ination (duration: 30	n., Default RS) ne can estimate that 0 min.). The type of		
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation					
6	Grading Module exan • Modul	m: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weighting: 100 %))		
7	Usability of M.Sc. ESE, M	t he module M.Sc. etit - EET, M.So	c. WI-etit, M.Sc. C	E, B.Sc. und M.Sc.	iST			
8	Grade bonu	is compliant to §25	(2)					
9	9 References							
	• Beyer,	M.; Boeck, W.; Mölle	er, K.; Zaengl, W.:	Hochspannungstee	chnik, Springer-Verla	g		
Coι	Courses							

Course nr. 18-kc-2010-vl	Course name High Voltage Technology II		
Instructor Prof. Dr. Myriam Koch		Type Lecture	SWS 2
Course nr. 18-kc-2010-ue	Course name High Voltage Technology II		
Instructor Prof. Dr. Myriam	Koch	Type Practice	SWS 1

Mo Hig	dule name h Voltage Sw	itchgear and Substat	ions					
Mo	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cy	cle
18-	kc-2020	3 CP	90 h	60 h	1 Term		Summer te	rm
Lan Ger	i guage man			Module owner Prof. Dr. Claus No	eumann			
1	 Theaching content This lecture covers the basic designs of high voltage substations as well as the design and working principles of high voltage switchgear: Switching processes and stresses induced by switching Arc behaviour in air, SF6 and vacuum Types of switchgear: earthing switches, disconnectors and circuit breakers Design and working principles of earthing switches and disconnectors in air and SF6 Design and working principles of circuit breakers: vacuum breakers, pressured air and SF6 breakers (thermal blast and self-blast chambers) Stresses on earthing switches and disconnectors in the event of short circuit Testing of switchgear Reliability of switchgear Future developments: Intelligent control of switchgear, static switches, superconducting switchgear 							
2	Learning ol The student usage in hig	ojectives should understand t h voltage substation	the purpose and w s.	orking principles o	of high volt	age switch	ngear as well	as their
3	Recomment Prior attend	ded prerequisites for ance of the lectures l	or participation High Voltage Tech	nology I and II is r	ecommend	ed		
4	Form of exa Module exa • Modul	mination m: e exam (Technical e:	xamination, Oral e	examination, Durat	ion: 45 Mi	n., Default	t RS)	
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical e:	xamination, Oral e	examination, Weigh	nting: 100	%)		
7	Usability of M.Sc. ESE, I	the module M.Sc. etit - EET, M.S	c. WI-etit, B.Sc. u	nd M.Sc. iST				
8	Grade bonus compliant to §25 (2)							
9	9 References A script of the lecture (in German) and the lecture slides will be provided.							
Coι	irses							
	Course nr. 18-kc-2020-	vl High Voltage S	Switchgear and Su	Ibstations				
	Instructor Prof. Dr. Cla	us Neumann, M.Sc.	Manuel Philipp			Type Lecture		SWS 2

Mo	Module name						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	kc-2030	3 CP	90 h	60 h	1 Term	Summer term	
Lar Ger	iguage man			Module owner Prof Dr Myriam	Koch		
1	Teaching co	ntont			itteri		
	 Teaching content Thunderstorms and Cloadclassification, formation and electrification Lightning, terminology, types, charge transfer, typical parameters Streamer- leader process, inception and development in large gaps Electric and magnetic fields in vicinity of lightning discharge Return stroke models, charge distributions and neutralization The Finite-Difference Time Domain Method for solving Maxwell's equations Lightning location, the technical use of field information Lightning effects in the middle and upper atmosphere Lightning protection and related threats, historical overview, standards and present lightning protection concepts Outer lightning protection, Lightning rods, down conductors, grounding systems, potential bonding and separation distances Inner lightning protection on transmission lines, faults and effects, calculation of outage rates and opportunities of improvement Lightning and surge protection for wind turbines 						
2	2 Learning objectives After successful completion of the module, the students know the inception, development and effects of natural lightning. They are able to differentiate between types of lightning and know all typical parameters, related to different surges and types of lightning. They know that the parameters may differ in different places over the earth and know the reason for this deviation. The students learn about all relevant components of a lightning strike as well as their technical relevance in lightning protection, surge protection and lightning location. The theory and most relevant models of lightning attachment and also its successive return stroke are known. All relevant lightning threats in terms of lightning protection are known and can be calculated. The students know how a standardized lightning protection system has to look like. They know about lightning protection levels, lightning protection zones and are able to apply measures on building, transmission lines and wind mills. The students know about simulation methodologies used in lightning research, taking into account the full retarded Maxwell equations. The students are aware of the uncertainties in lightning protection and lightning research. They know about open questions in the field of research related to the inception, discharge and effects of lightning. The students learn about unconventional lightning protection, which cannot be found in the standard, and also						
3	Recommend Recommend	ded prerequisites fo led: BSc etit, BSc Wi-	or participation -etit				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS) The examination takes place in form of a written exam (duration: 120 minutes). If one can estimate that less than 10 students register, the examination will be an oral examination (duration: 30 min.). The type of examination will be announced in the beginning of the lecture. Form of examination of the examination of the lecture. 						
5	recquisit		real points				

	Passing the final	module examination					
6	Grading Module exam: • Module exa	GradingModule exam:Module exam (Technical examination, Oral/written examination, Weighting: 100 %)					
7	Usability of the M.Sc. ESE, M.Sc.	module etit - EET, M.Sc. WI-etit					
8	Grade bonus co	mpliant to §25 (2)					
9	ReferencesLecture slides and other information material supporting the lecture will be provided. IEC test standards can beleant out for use during the lecturer time.• Blitz und Blitzschutz, F. Heidler, K. Stimper, ISBN 978-3-8007-2974-6• Handbuch für Blitzschutz und Erdung, P. Hasse, J. Wiesinger, W. Zischank, ISBN 978-3-7905-0657-0• Blitzschutzanlagen: Erlauterungen zu DIN 57 185/VDE 0185, VDE-Verlag, ISBN 978-3-8007-1303-9• Lightning, Physics and Effects, V.A. Rakov, M.A. Uman, ISBN 978-0-521-03541-5• Lightning Physics and Lightning Protection, E.M. Bazelyan, Y.P. Raizer, ISBN 978-0-750-30477-1• Electromagnetic Computation Methods for Lightning Surge Protection Studies, Y. Baba, V.A. Rakov, ISBN 978-1-118-27563-4• Lightning Electromagentics, V. Cooray, ISBN 978-1-84919-215-6• Lightning: Principles, Instruments and Application, H.D. Betz, U. Schumann, P. Laroche, ISBN 978-1-4020-9078-3						
Coι	ırses						
	Course nr.Course name18-kc-2030-vlBlitzphysik und Blitzschutz						
	Instructor DrIng. Martin H	lannig	Type Lecture	SWS 2			

Mo	Module name Power Cable Systems							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18-	kc-2060	3 CP	90 h	60 h	1 Term	Winter term		
Lar Ger	iguage man/English			Module owner Prof. Dr. Myriam	Koch			
1	 Teaching content In the lecture, in addition to theoretical knowledge, also the practical side of high voltage cable technology will be treated. These are technical issues, e.g. water sensitivity of plastic cables, cable inspection, testing of already installed cables and the latest developments as in the field of superconductivity etc The contents of the lecture are: Cable construction: materials / requirements / design Cable Manufacturing: conductors / extrusion / shield / sheath (oil-paper insulation) / reinforcement Quality requirements and routine-/selection-/type- long term test / ISO 9001, standards, aging, endurance Cable Systems: load / mech. requirements / ind. voltage / short circuit requirements / transient requirements / installation techniques Design and operation: route planning / laying / commissioning / monitoring / maintenance Trends: High-temperature superconductivity, Submarine cable, DC cable, forced cooling, GIL 							
2	Learning ol Students lea the design o The student	bjectives arn the basic structur of a high voltage cable s are also able to eva	e of a cable. They e. The basics of ma luate new trends	know the technica anufacturing techn in cable technology	l requirements both ology and the necess	for the material and ary tests are learned.		
3	Recommen BSc. ETiT E	ded prerequisites for lectrical Power System	or participation ms					
4	Form of exa Module exam • Modul The examina 4 students re will be anno	amination m: le exam (Technical ex ation takes place in fo egister, the examinat bunced in the beginni	kamination, Oral/ orm of a written ex ion will be an ora ing of the lecture.	written examinatio am (duration: 90 n l examination (dur	n, Duration: 90 Min. ninutes). If one can es ation: 30 min.). The	., Default RS) stimate that less than type of examination		
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation					
6	 6 Grading Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 							
7	7 Usability of the module M.Sc. ESE, M.Sc. etit - EET, M.Sc. WI-etit							
8	8 Grade bonus compliant to §25 (2)							
9	References Slides, litrat	ure sources						
Co	ırses							

Course nr. 18-kc-2060-vl	Course name Power Cable Systems		
Instructor M.Sc. Tobias Tra	utmann, Dr. Ing. Johannes Kaumanns	Type Lecture	SWS 2

Mo Elee	Module name Electromagnetic Compatibility						
Mo	dule nr. kc-2070	Credit points	Workload 120 h	Self-study 75 h	Module duration	Module cycle Winter term	
Lar Ger	iguage man	101	120 11	Module owner Prof. Dr. Myriam	Koch		
1	Teaching co Fundamenta components VDE Offenba	ontent als of Electromagnetic 5 for noise suppressio ach	Compatibility, sou n, electromagneti	rces of emission, co c shields, EMC mea	upling mechanisms a asuring and test tech	nd counter measures, niques, excursion to	
2	2 Learning objectives The students know that from every electromagnetic system a interaction is possible and that every electromagnetic (and also biological) system can be effected; they can differ between typical interference sources and sinks; they know the typical coupling paths and can identify and describe them mathematically; they know the basic methods to avoid interference at the source side and can derive their own actions against interference from this basic understanding; they know the basic actions to avoid interference at the sink side and can also derive actions to avoid interference; they have the ability to recognize coupling paths and can systematically influence or interrupt them completely; they know the situation of the EMC standardization and know basically which requirements have to be fulfilled and how to do this (also i.e. how to give a device a CE-label); they have learned the most important EMC testing and measurement techniques theoretically and practically know on the field trip.						
3	Recommen	ded prerequisites fo	or participation				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS) The examination takes place in form of a written exam (duration: 120 minutes). If one can estimate that less than 20 students register, the examination will be an oral examination (duration: 20 min.). The type of 						
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	Grading Module exame • Modul	m: le exam (Technical ex	xamination, Oral/	written examinatio	n, Weighting: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, M.Sc. CE, B.S	c. und M.Sc. iST		
8	Grade bonu	is compliant to §25	(2)				
9 Coi	 9 References All lecture slides (ca. 500 pcs.) available for download Adolf J. Schwab: Elektromagnetische Verträglichkeit, Springer-Verlag Clayton R. Paul: Introduction to Electromagnetic Compatibility, Wiley & Sons 						
Course nr. 18-kc-2070-vl	Course name Electromagnetic Compatibility						
------------------------------------	-----------------------------------------------------	-------------	------------				
Instructor		Type	SWS				
Dr. Ing. Torsten Psotta		Lecture	2				
Course nr. 18-kc-2070-ue	Course name Electromagnetic Compatibility						
Instructor		Type	SWS				
Dr. Ing. Torsten Psotta		Practice	1				

Mo Rela	dule name ativistic Electr	odynamics						
Mo	dule nr. kb-2020	Credit points	Workload	Self-study 90 h	Module of 1 Term	duration	Module cyc Winter tern	cle
Lan Ger	n guage man/English		100 1	Module owner Prof. DrIng. Har	ald Klingb	eil		
1	Teaching co Basics of ten differential o Doppler effe relativistic m stress tensor	ontent sor analysis (tensor f operators), Lorentz ct), covariant form o nechanics, four-vecto , applications of rela	fields, transformat transform, fundar f Maxwell's equations ors and four-tenson tivistic electrodyn	ion behavior, invar nental relativistic e ions, induction law rs, electromagnetic amics	iance, Ricc effects (tim from relat energy-mo	ti calculus, ne dilation ivistic poin omentum t	covariant der , length cont at of view, rela ensor and Ma	rivative, raction, ation to axwell's
2	2 Learning objectives The students understand the basic ideas of Special Relativity and are familiar with the scientific vocabulary. They are able to derive and interpret fundamental formulas, and they are familiar with the mathematical tools. The students understand the concept of covariance and a coordinate-free description of physical theories. They are able to quantitatively compute electromagnetic phenomena in the context of Special Relativity.							
3	Recommend "Grundlagen	led prerequisites fo der Elektrodynamik	or participation (18-dg-1010)					
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Oral e	examination, Durat	ion: 30 Mi	in., Default	t RS)	
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical ex	xamination, Oral e	examination, Weigh	nting: 100	%)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - SAE, M.S	Sc. etit - EET, M.S	c. CE, M.Sc. etit - C	CMEE			
8	Grade bonu	s compliant to §25	(2)					
9	References	es are offered for dou	wnload Further re	ferences are given	in the lect	1170		
Coι	irses		vilload. Further re	incremees are given				
	Course nr. 18-kb-2020-	vl Relativistic Ele	ectrodynamics					
	Instructor Prof. DrIng	. Harald Klingbeil				Type Lecture		SWS 2
	Course nr. 18-kb-2020-	Course name ue Relativistic Ele	ectrodynamics		.			
	InstructorTypeSWSProf. DrIng. Harald Klingbeil, M.Sc. Sebastian Orth, M.Sc. Yi Jin, M.Sc.Practice2Christoph Wegmann2							

Mo Rac	dule name lio Frequency	Systems for Particle	Accelerators					
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle
Lan	nguage glish	5.01	150 11	Module owner Prof. DrIng. Har	ald Klingb	eil	Builliner te	1111
1	Teaching co Repetition o loaded with beam loadin particle track loop and ope	ntent f transmission lines magnetically perme g, basic terms and c king equations, Liouv en-loop control (LLR	and waveguides, able materials, cav lefinitions of nonl rille's theorem, adi F) systems.	S-parameters. RF vities based on clas inear dynamics, R abaticity, RF systen	componen sical reson F accelera ns for spec	nts, RF me ators, cavi tion, longi ial beam m	asurements, ty equivalent tudinal phase anipulations,	cavities circuit, e space, , closed-
2	2 Learning objectives Students know important RF components and sub-systems for particle accelerator cavities. They are able to describe them mathematically (e.g. by means of S-parameters), and they are familiar with the operating principle of different types of cavities for particle accelerators and their sub-systems and components. The description of RF manipulations in longitudinal phase space and related terms and definitions are known to them. The students are able to calculate different phenomena of accelerator technology quantitatively.							
3	Recommend	led prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Technical ez	κamination, Oral ε	examination, Weigh	nting: 100	%)		
7	Usability of M.Sc. WI-eti	the module t, M.Sc. etit - KTS, N	1.Sc. iCE, B.Sc. ur	nd M.Sc. iST, M.Sc.	etit - CMI	EE		
8	Grade bonu	s compliant to §25	(2)	,				
9	References Lecture slide	es are offered for dow	vnload. Further re	eferences are given	in the lect	ure.		
Coι	ırses							
	Course nr. 18-kb-2040-	vl Radio Frequer	icy Systems for Pa	rticle Accelerators				
	Instructor Prof. DrIng	Harald Klingbeil				Type Lecture		SWS 2
	Course nr. 18-kb-2040-	ue Radio Frequer	icy Systems for Pa	rticle Accelerators				
	Instructor Prof. DrIng Christoph W	g. Harald Klingbeil, egmann	M.Sc. Sebastian	ı Orth, M.Sc. Yi J	in, M.Sc.	Type Practice		SWS 2

М	dulo nomo							
Lig	hting Technol	ogy I						
Mo 18-	dule nr. kh-2010	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module 1 Term	duration	Module cyc Winter tern	c le n
Lar Ger	nguage rman			Module owner Prof. DrIng. Tra	n Quoc Kł	nanh	1	
1	Teaching co Structure and and photom Measureme responsivity optical mate	ontent ad functionality of the etric properties of m nt of luminous flux, function of the hun erial characteristics, I	ne human eye, tern aterials, filters, ph luminous intens nan eye, colorime LED properties	ns and unit in ligh ysiology of vision, ity, illuminance, lu try colour renderir	ting techn colour the iminance, ng, colour	ology, pho ory, lightin determina as traffic s	tometry, radio g, light sourc ation of the s ignals, measu	ometric es. spectral iring of
2	 2 Learning objectives On completion of the module students will have learned the following: To list and connect terms, units and radiometric and photometric properties of materials in lighting technology to describe and understand structure and functionality of the human eye and the physiology of vision to illustrate basics of lighting, measuring methods and application. They are able to measure base items in lighting technology, applying knowlegde of lighting and enhance them with experiments and have developed a better understanding for light and color. 							
3	Recommended prerequisites for participation MSc ETiT, MSc Wi-ETiT, MSc MEC							
4	Form of exa Module exa • Modul	mination n: e exam (Technical e:	xamination, Oral e	examination, Durat	ion: 30 M	in., Defaul	t RS)	
5	Prerequisite Passing the	e for the award of c final module examin	r edit points ation					
6	Grading Module exa • Modul	n: e exam (Technical e	xamination, Oral e	examination, Weigh	nting: 100	%)		
7	Usability of B.Sc. etit, M WI-etit	the module I.Sc. MEC, M.Sc. et	it - SAE, M.Sc. W	I-etit, M.Sc. CE, M	I.Sc. Meď	Tec, B.Sc.	und M.Sc. iS	T, B.Sc.
8	Grade bonu	s compliant to §25	(2)					
9	9 References Script for lecture: Lighting Technology I Excersisebook: laboratory: lighting technology I							
Coi	urses							
	Course nr. 18-kh-2010-	Course namevlLighting Techn	nology I					
	Instructor Prof. DrIng	. Tran Ouoc Khanh	DrIng. Babak Za	ndi, M.Sc. Felix Wi	rth	Type Lecture		SWS

	Course nr. 18-kh-2010-pr	Course name Lighting Technology I		
	Instructor Prof. DrIng. Tra	n Quoc Khanh, DrIng. Babak Zandi, M.Sc. Felix Wirth	Type Lab	SWS 2

Mo	dule name						
Adv	anced Lighting	Technology		1		1	
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle rm
Lan		0.01	100 11	Module owner			
German Prof. DrIn				Prof. DrIng. Tra	n Quoc Khanh		
1	Teaching con Chosen topics Detektion / G of Light Meas Automotive Li	a tent s in lighting techno lare / Lighing and surement, Interiou ghting, Solar Modu	ology - current de Health, LED - Ge r Lighting, Displa ıles.	evelopments and a neration of white I y Technologies, N	applications: Street ight / State of the A on-visual Light Impa	lighting, Phy rt, Modern N acts,UV-Appli	siology: Iethods cations,
2	2 Learning objectives On completion of the module students will have learned the following: They know current developments and applications, list and connect terms, to illustrate special topics of lighting, measuring methods and application. They are able to measure base items in lighting technology, applying knowlegde of lighting and dedicated applications and further to enhance them with experiments. They have developing a better understanding for light, color, perception and lighting situations.						
3	Recommende Lighting Tech	Recommended prerequisites for participation Lighting Technology I					
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the fi	for the award of c nal module examina	redit points ation				
6	Grading Module exam • Module	: exam (Technical e:	xamination, Oral 6	examination, Weigl	nting: 100 %)		
7	Usability of t M.Sc. MEC, M	he module I.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, M.Sc. MedTec,	B.Sc. und M.Sc. iST		
8	Grade bonus	compliant to §25	(2)				
9	References Excercisebool	: laboratory: lighti	ng technology II				
Coi	ırses						
	Course nr. 18-kh-2020-v	Course nameAdvanced Light	nting Technology				
	Instructor Prof. DrIng.	Tran Quoc Khanh			Type Lecture		SWS 2
	Course nr. 18-kh-2020-p	r Advanced Ligh	nting Technology				
	InstructorTypeSWSProf. DrIng. Tran Quoc KhanhLab2						

Mo	dule name	ies in Car Lighting					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle
18-	KN-2041	4 CP	120 h	75 h	1 Ierm	Summer ter	rm
Ger	rman			Prof. DrIng. Tra	n Quoc Khanh		
1	1 Teaching content History and standardisation of car lithing. Description of the oused lighting sources and the function of these(lowbeam, highbeam, bending light, stop lamp, daytime running light), visuell perception, glare, detection, traffic infrastructure, traffic elements, interior lighting, driver assistance systems(GPS, Radar, Lidar), methods of psychophysics, lighting application concepts in future automated vehicles. Voluntary trip planed to an automobile manufacturer						
2	 Learning objectives Upon completion of the module, students will have learned to describe the basics and deepening knowledge of car lighting, to understand the light distribution of head and rear lamps, to learn the basics of standardisation, enlarge glare and detection skills, know the traffic elements, as well as the driver assistance systems. 						
3	Recommend Lighting tech	ed prerequisites f o nology 1	or participation				
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation				
6	Grading Module exam • Module	: exam (Technical e:	xamination, Oral e	examination, Weigh	nting: 100 %)		
7	Usability of t M.Sc. MEC, M	he module /I.Sc. etit - SAE, M.S	Sc. WI-etit, B.Sc. ι	ınd M.Sc. iST			
8	Grade bonus	compliant to §25	(2)				
9	References Lecture slides	, Automotive Light	ing and Human Vi	sion, Handbuch Fa	hrassistenzsysteme		
Co	ırses						
	Course nr. 18-kh-2041-v	l Optical Techno	ologies in Car Ligh	nting			
	Instructor Prof. DrIng.	Tran Quoc Khanh			Type Lecture		SWS 2
	Course nr. 18-kh-2041-p	r Optische Tech	nologien im KFZ-I	Bereich			
	Instructor Prof. DrIng. Tran Quoc Khanh				Type Lab		SWS 1

Mo Sol	dule name id State Lighti	ng					
Mo 18-	dule nr. kh-2060	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration 1 Term	Module cyc Winter tern	cle n
Lar Ger	iguage man		1	Module owner Prof. DrIng. Tran Quoc Khanh			
1	Teaching co Basics of ligh optics, phosp of LEDs; LEI engineering; sources; cho according to colour recog training: the	ntent t and colour percept phors; phosphor mi d models; lifetime a optical sensors; ser ice and combinatio their technological nition, spectral reco rmic, electric and lig	ion; basics of solid xtures; colour an ind defect mechar niconductor based on of LEDs in prace parameters; ligh onstruction; intelli ghting engineering	state light sources d white LEDs; tem hisms of LEDs; OLF d cameras; colour s ctical LED luminai ting quality metric igent automotive a g related measurem	; LEDs: material syst perature, current a EDs and semiconduc ensors; colour qual res; flicker; groupin rs; intelligent indoo nd outdoor lighting ent of LED light sou	ems, structura nd optical bel ctor lasers in l ity of solid sta ng (binning) o r lighting with with LEDs; p urces.	ll shape, haviour lighting ite light of LEDs h LEDs: ractical
2	Learning objectives Principles and applications of the technology of solid state light sources in lighting engineering; LED technology and the optimisation of visual perception under LED light in modern lighting engineering.						
3	Recommended prerequisites for participation Lichttechnik I, II						
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the f	for the award of c inal module examin	redit points ation				
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Oral e	examination, Weigl	nting: 100 %)		
7	Usability of M.Sc. etit - S	the module AE, M.Sc. WI-etit, N	И.Sc. CE				
8	Grade bonu	s compliant to §25	(2)				
9	References						
	 LED-Lighting: Technology and Perception (Khanh, Bodrogi, Vinh, Winkler; Editors, Wiley-VCH, 2015) Introduction to Solid State Lighting (Zukauskas et al., Wiley, 2002) Light Emitting Diodes (Schubert; Cambridge Univ. Press, 2003) 						
Coι	urses						
	Course nr. 18-kh-2060-v	Course namevlSolid State Lig	ghting				
	Instructor Prof. DrIng.	Tran Quoc Khanh,	DrIng. Alexande	r Herzog	Type Lecture		SWS 2

Course nr. 18-kh-2060-pr	Course name Praktikum Halbleiterlichttechnik		
Instructor Prof. DrIng. Tra	n Quoc Khanh, DrIng. Alexander Herzog	Type Lab	SWS 2

34								
Cor	Module name Communication Technology II							
Mo 18-1	dule nr. kl-2010	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration 1 Term	Module cycle Winter term		
Lan Eng	iguage dish			Module owner Prof. DrIng. Anj	a Klein	1		
1	Teaching co Linear and a channel cap schemes, OF	ontent nonlinear digital mo acity, channel model FDM	dulation schemes s, channel estima	, optimum receive tion and data deteo	rs for AWGN channe ction for multipath cl	els, error probability, hannels, multicarrier		
2	 2 Learning objectives After completion of the lecture, students possess: the ability of comparing, evaluating, classifying an analyzing linear and nonlinear modulation schemes by means of signal space representations; the ability to understand, describe and analyze the influence of AWGN on the signal; the ability to understand and derive optimum receivers in case of AWGN channels; the ability to understand, describe and analyze the influence of multipath propagation on the signal; the ability to understand, describe and analyze the influence of multipath propagation on the signal; the ability to describe the influence of a multipath channel mathematically (channel model) and estimate the multipath channel at the receiver; the knowledge of equalizing the received signal in order to undo the influence of multipath propagation, as well as the ability to derive and design several equalizer structures; the ability to analyze and evaluate the properties and application areas of multicarrier transmission systems, e.g. OFDM-systems; the ability to design and evaluate the system parameters of multicarrier schemes for the application in realistic wireless communication scenarios; the ability to mathematically express and analyze all above system models in matrix-vector-notation. 							
3	Recommen Deterministi I to III. Stati	ded prerequisites fo sche Signale und Syst stics/Probability The	r participation teme, Communica corv. Scientific Cor	tion Technology I, E nputing	Basics of Telecommun	ication, Mathematics		
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	amination, Exam	ination, Duration:	90 Min., Default RS)			
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation					
6	Grading Module exan • Modul	m: e exam (Technical ex	amination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. et	tit - KTS, M.Sc. iC	E, B.Sc. und M.Sc.	iST, M.Sc. etit - VAS			
8	Grade bonus compliant to §25 (2)							
9 Coi	References will be anno	ounced in the lecture						

Course nr. 18-kl-2010-vl	Course name Communication Technology II		
Instructor Prof. DrIng. Anja Klein		Type Lecture	SWS 2
Course nr. 18-kl-2010-ue	Course name Communication Technology II		
Instructor Prof. DrIng. An	ja Klein, M.Sc. Yi Wang, M.Sc. Sumedh Dongare	Type Practice	SWS 2

Мо	Module name							
Mo	bile Commun	ications						
Mo	dule nr. kl-2020	Credit points	Workload 180 h	Self-study 120 h	Module duration	Module cycle		
Lar	iguage	0.01	100 11	Module owner	1 101111	builder term		
Eng	glish			Prof. DrIng. Anj	a Klein			
1	The lecture covers aspects of mobile communication systems with particular focus on the physical layer. • Mobile radio systems, services, market, standardization • Duplex and multiple access techniques, cellular concept • Mobile radio channel, deterministic and stochastic description • Modulation schemes • Code division multiple access (CDMA) • Orthogonal frequency division multiplexing (OFDM) • Optimum and suboptimum receiver techniques • Cellular radio capacity and spectrum efficiency • Diversity methods • Multiple input multiple output (MIMO) systems • Power control and handover • Architecture of mobile radio systems							
2	 2 Learning objectives After completion of the module, students possess a profound understanding of physical layer aspects ,e.g., transmission schemes, multiple access schemes of mobile communication systems, duplex schemes, multi carrier schemes, receiver techniques, multi antenna schemes a profound understanding of signal propagation in mobile radio systems (mobile radio channel) the ability to understand and solve problems of the field of the physical layer the ability to compare, analyse and evaluate different system concepts knowledge on modelling of the transmission properties of the mobile radio channel 							
3	Recommend Determinist Theory, Scie	ded prerequisites for ic Signals and Syster ntific Computing	or participation ms, Communication	on Technology I, M	athematics I to III, S	Statistics/Probability		
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)			
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	GradingModule exam:Module exam (Technical examination, Examination, Weighting: 100 %)							
7	Usability of M.Sc. WI-et	t he module it, M.Sc. etit - KTS, M	I.Sc. iCE, B.Sc. ur	nd M.Sc. iST, M.Sc.	etit - VAS			
8	Grade bonu	is compliant to §25	(2)					
9	References							

	will be announced in the lecture						
Co	Courses						
	Course nr. 18-kl-2020-vl	Course name Mobile Communications					
	Instructor Prof. DrIng. Anja Klein, DrIng. Lin Xiang		Type Lecture	SWS 3			
	Course nr. 18-kl-2020-ue	Course name Mobile Communications					
	Instructor Prof. DrIng. Anja Klein, DrIng. Lin Xiang		Type Practice	SWS 1			

Mo Fur	dule name idamentals of	Reinforcement Learn	ning				
Mo 18-	dule nr. kl-2070	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Summer term	
Lar Eng	iguage glish	1		Module owner Prof. DrIng. Anj	a Klein	1	
1	 Teaching content Review of Probability Theory Markov Property and Markov Decision Processes The Multi-Armed Bandit Problem vs. the Full Reinforcement Learning Problem Taxonomy of Multi-Armed Bandit Problems (e.g., Stochastic vs. Adversarial Rewards, Contextual MAB) Algorithms for Multi-Armed Bandit Problems (e.g., Upper Confidence Interval (UCB), Epsilon-Greedy, SoftMax, LinUCB) and their Application to Cyber-Physical Networking Fundamentals of Dynamic Programming and Bellman Equations Taxonomy of Approaches for the Full Reinforcement Learning Problem (e.g., Temporal-Difference Learning, Policy Gradient and Actor-Critic) Algorithms for the Full Reinforcement Learning Problem (e.g., Q-Learning, SARSA, Policy Gradient, Actor-Critic) and their Application to Cyber-Physical Networking Linear Function Approximation Non-linear Function Approximation 						
2	 Non-linear Function Approximation Non-linear Function Approximation Learning objectives The students are able to define the Markov property and identify the elements that constitute a Markov decision process. They will be able to use these concepts to model decision-making problems in Cyber-Physical Networking. determine the characteristics of the Multi-Armed Bandit (MAB) Problem and compare them to the characteristics of the Full Reinforcement Learning (RL) Problem. determine under which conditions the MAB or the full RL formulation should be used to solve decision making problems. differentiate the main MAB strategies, e.g., Upper Confidence Interval (UCB), Epsilon-Greedy and Softmax choose appropriate MAB strategies for the solution of MAB problems. formulate and solve Contextual-MAB problems. determine under which conditions Dynamic Programming can be used to solve decision-making problems. differentiate between Temporal-Difference, Policy Gradient and Actor-Critic RL techniques. identify the limitations of MAB and full RL problems. explain the need for generalization in MAB and full RL problems. choose appropriate approximation techniques and use them in combination with MAB and full RL strategies 					on process. They will Networking. e them to the charac sed to solve decision Greedy and Softmax on-making problems niques. and full RL strategies lutions.	
3	Recomment • Pythor • Engine	ded prerequisites fo n or Matlab: basic kno pering mathematics a	r participation owledge nd probability the	eory			
4	Form of exa	mination					

	 Module exam: Module exam (Technical examination, Oral/written examination, Duration: 60 Min., Default RS) The examination takes place in form of a written exam (duration: 60 minutes). If one can estimate that less than 21 students register, the examination will be an oral examination (duration: 20 min.). The type of examination will be announced in the beginning of the lecture. 					
5	Prerequisite for Passing the final	the award of credit points module examination				
6	GradingModule exam:Module exam (Technical examination, Oral/written examination, Weighting: 100 %)					
7	Usability of the module M.Sc. MEC, M.Sc. WI-etit, M.Sc. etit - KTS, M.Sc. etit - AUT, M.Sc. iCE, B.Sc. und M.Sc. iST, M.Sc. etit - VAS					
8	Grade bonus co	mpliant to §25 (2)				
9	 References Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", A Bradford Book, Cambridge, MA, USA, 2018. Aleksandrs Slivkins, "Introduction to Multi-Armed Bandits", Foundations and Trends in Machine Learning, Vol. 12: No. 1-2, 2019. 					
Co	urses	1				
	Course nr. 18-kl-2070-vl	Course name Fundamentals of Reinforcement Learning				
	Instructor Dr. rer. nat. Sabi	rina Klos, DrIng. Andrea Jimenez	Type Lecture	SWS 2		
	Course nr. 18-kl-2070-ue	Course name Fundamentals of Reinforcement Learning				
	Instructor		Type Practice	SWS 1		

Mo Ser	dule name Isor Techniqu	e				
Mo 18-	dule nr. kn-2120	Credit points 4 CP	Workload 120 h	Self-study 75 h	Module duration 1 Term	Module cycle Winter term
Lar Ger	iguage man	I		Module owner Prof. Dr. Mario K	upnik	
1	1 Teaching content The module teaches basic principles of different sensors and the required knowledge for correct application of sensors. With regard to the measurement chain, the focus of the course is on the conversion of any, generally non-electrical quantities into electrically evaluable signals. Resistive, capacitive, inductive, piezoelectric, optical, and magnetic measurement principles are covered in the module to provide knowledge of the measurement of important quantities such as force, torque pressure, acceleration, velocity, displacement, and flow. In addition to a phenomenological description of the principles and a derived technical description, the main elements of primary and secondary electronics for each measurement principle will also be presented and understood. In addition to the measurement principles, the description of errors will be dealt with. In addition to static and dynamic errors, errors in signal processing and error consideration of the entire measurement chain will be discussed. In the exercises the method of peer instruction is utilized.					
2	Learning objectives The Students acquire knowledge of the different measuring methods and their advantages and disadvantages. They can understand error in data sheets and descriptions interpret in relation to the application and are thus able to select a suitable sensor for applications in electronics and information, as well process technology and to apply them correctly.					
3	Recomment Measuring T	ded prerequisites fo Technique	or participation			
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation			
6	Grading Module exa • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, M.Sc. MedTec,	B.Sc. und M.Sc. iST	, B.Sc. WI-etit
8	Grade bonus compliant to §25 (2)					
9 Со	References • Slide set of lecture • Script of lecture • Textbook Tränkler "Sensortechnik", Springer • Exercise script					

Course nr. 18-kn-2120-vl	Course nr.Course name.8-kn-2120-vlSensor Technique				
Instructor Prof. Dr. Mario K	upnik, M.Sc. Sven Suppelt	Type Lecture	SWS 2		
Course nr. 18-kn-2120-ue	Course name Sensor Technique				
Instructor Prof. Dr. Mario K	upnik, M.Sc. Sven Suppelt	Type Practice	SWS 1		

3.4	dula m					
Dat	aule name a-driven Mod	leling - Machine Leai	rning			
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	kp-2110	6 CP	180 h	120 h	1 Term	Summer term
Lar	iguage rlish			Prof. Dr. techn. H	leinz Köppl	
1	Teaching co	ontent				
	 I Teaching content The module provides an introduction to the emerging field of machine learning from an engineering perspective Important models and learning methods are presented and exemplified through problems from information and communication technology. Fundamentals of probability theory and multivariate statistics Taxonomy of machine learning problems and models (supervised, unsupervised, generative, discriminative) Regression and classification: theory, methods and ICT applications Dimensionality reduction, clustering and big data analytics: methods and application in communications and signal processing Probabilistic graphical models: categories, inference and parameter estimation Fundamentals of Bayesian inference, Monte Carlo methods, Bayesian non-parametrics Fundamentals of convex optimization: Solution methods and application in communications Approximate algorithms for scalable Bayesian inference; application in signal processing and information theory (e.g. decoding of LDPC codes) Hidden Markov models (HMM): Theory, Algorithms and ICT applications (e.g. Viterbi decoding of convolutional codes) High-dimensional statistics ("large p small n" setting), learning dependency structure in high-dimensional data, learning causality relations from observational data. Sparse estimation, random projections, compressive sensing: Theory and applications in signal processing Deep neural networks (deep learning): Models, learning algorithms, libraries and ICT applications 					
2	Learning ol Students are machine lea They are al mine suitabl	bjectives e able to interpret ar rning problems. ble to reduce such le solution methods f	nd categorize spec problems to star for them.	tific engineering pr ndard machine lea	oblems from the ICT rning problems and	domain in terms of are able to deter-
	They are al state-of-the-	ble to implement al art libraries in mach	ll necessary algor ine learning.	rithms from scrate	h, but they are als	o familiar with the
	They are al priate soluti	ble to determine th on algorithms based	e involved comp on application co	utational complex nstraints.	ity of a method an	d choose an appro-
	They are a engineering	ble to apply the ac , analysis of social ne	cquired methods etwork data, etc.	to other domains	s, such as data ana	alysis in biomedical
3	Recommended prerequisites for participationGood command of Matlab (for instance knowledge from course 18-st-2030 Matlab Grundkurs) and engineeringmathematics					urs) and engineering
4	Form of exa Module exam • Modul The examin less than 10 examination	amination m: le exam (Technical e: lation takes place in) students register, th n will be announced i	xamination, Oral/ form of a written ne examination wi in the beginning o	written examinatio n exam (duration: ill be an oral exam f the lecture.	n, Duration: 120 Mir 120 minutes). If or ination (duration: 3	n., Default RS) ne can estimate that 0 min.). The type of

5	Prerequisite for the award of credit points Passing the final module examination					
6	GradingModule exam:Module exam (Technical examination, Oral/written examination, Weighting: 100 %)					
7	Usability of the M.Sc. etit - DT, M M.Sc. etit - CME	module 1.Sc. WI-etit, M.Sc. CE, M.Sc. etit - KTS, B.Sc. CE, M.Sc. iC E, M.Sc. etit - VAS	E, B.Sc. und M.Sc. iST, B.S	c. WI-etit,		
8	Grade bonus co	mpliant to §25 (2)				
Cor	 References Kevin P. Murphy. Machine Learning - A probabilistic perspective, MIT Press, 2012 Christopher M. Bishop. Pattern recognition and Machine Learning, Springer, 2006 Peter Bühlmann und Sara van de Geer. Statistics of high-dimensional data - Methods, theory and applications, Springer, 2011 					
	Course nr. 18-kp-2110-vl	Course name Data-driven Modeling - Machine Learning				
	Instructor Prof. DrIng. An	a Klein, Prof. Dr. techn. Heinz Köppl	Type Lecture	SWS 2		
	Course nr. 18-kp-2110-ue	Course name Data-driven Modeling - Machine Learning				
	Instructor Prof. DrIng. An	a Klein, Prof. Dr. techn. Heinz Köppl	Type Practice	SWS 1		
	Course nr. 18-kp-2110-pr	Course name Data-driven Modeling - Machine Learning Lab				
	Instructor Prof. DrIng. An	a Klein, Prof. Dr. techn. Heinz Köppl	Type Lab	SWS 1		

Mo	dule name					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	kp-2120	3 CP	90 h	60 h	1 Term	Winter term
Eng	glish			Prof. Dr. techn. H	leinz Köppl	
1	Teaching co	ontent		I		
	 Elementary methods of machine learning: Regression, classification, clustering (probabilistic graphical models) Analysis and visualization of high-dimensional data (multi-dimensional scaling, principal component analysis, embedding methods with deep neural networks, tSNE, UMAP) Data-driven reconstruction of molecular interaktion networks (Bayes nets, solution to Gausian graphical models, Causality analysis) Analysis of interaction networks (modularity, graph partitioning, spanning trees, differential networks, network motifs, STRING database, PathBLAST) Dynamical models of molecular interaction networks (stochastic Markov-modes, differential equations, Reaction rate equation) Elementary algorithms for structure determination of proteins and RNAs (Secondary structure prediction of RNAs, molecular dynamics, common simulators and force fields) 					
2	Learning objectives After successful completion of this module, students will be familiar with current statistical methods for analyzing high-throughput data in molecular biology. They know how to analyze high-dimensional data by reduction, visualization and clustering and how to find dependencies in these data. They know methods for dynamic description of molecular interactions. They are aware of common methods for structure prediction of biomolecules. Upon completion, students will be able to independently implement the presented algorithms in programming languages, such as Python, R or Matlab. In the area of communicative competence, students have learned to exchange information, ideas, problems and solutions in the field of bioinformatics with experts and with lavpersons					
3	Recommend Bioinformati	ded prerequisites fo ics I	or participation			
4	Form of examination Module exam: • Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 11 students register, the examination will be an oral examination (duration: 30 min.). The type of examination will be announced in the beginning of the lecture					
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 					
7	Usability of M.Sc. WI-eti	the module it, M.Sc. MedTec, M.	Sc. etit - CMEE			
8	Grade bonu	s compliant to §25	(2)			
9	References					

Co	Courses							
	Course nr. 18-kp-2120-vl	Course name Bioinformatics II						
	Instructor Prof. Dr. techn. Heinz Köppl		Type Lecture	SWS 2				

Mo	dule name					
Intr Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cvcle
18-	me-2020	6 CP	180 h	120 h	1 Term	Winter term
Lan Eng	iguage ;lish			Module owner Prof. Dr. rer. nat.	Markus Meinert	
1	1 Teaching content The lecture covers the following subjects: • Basics of atomic physics (structure of the atoms, electron hull) • Basics of solid state physics (crystalline materials) • Introduction to electron transport in solids (classical treatment, band structures) • Basic notions and simple models of magnetism • Magnetism in thin films • Spin-dependent electronic transport • Magnetoresistive effects, anisotropic magnetoresistance • Giant magnetoresistance (GMR) • Tunneling magnetoresistance (TMR) • Spin-Transfer Torque • Magnetic microwave oscillators • Spin-Hall effect and other spin-orbit effects • Magnetic data storage • Spintronic devices as sensors • Magnetic random-access memory (MRAM)					
2	Learning ol The students application to make use scientific lite	ojectives s learn fundamental o of spintronic devices of spintronic devices erature and to dive de	concepts of spintro in data storage a s in applications. ' eeper into the fiel	nics, from propertion nd magnetic sensir They further acquir d.	es of magnetic materi ng. The students acq re the competence to	als to the design and uire the competence understand current
3	Recommen Module 11-0	ded prerequisites fo 01-6419 Materials of	or participation Electrical Enginee	ering		
4	Form of exa Module exa • Modul The examin less than 16 examination	amination m: e exam (Technical ex ation takes place in students register, th a will be announced i	kamination, Oral/ form of a written ne examination wi n the beginning o	written examinatio n exam (duration: ill be an oral exam f the lecture.	n, Duration: 120 Min 120 minutes). If or ination (duration: 4	n., Default RS) ne can estimate that 5 min.). The type of
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exame • Module	m: e exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of M.Sc. etit -	the module SAE, M.Sc. iCE				
8	Grade bonu Yes	is compliant to §25	(2)			
9	References					

- A script will be made available electronically
- Coey, Magnetism and Magnetic Materials, 2009, Cambridge University Press
- Skomski, Simple Models of Magnetism, 2008, Oxford University Press
- Felser, Fecher, Spintronics: From Materials to Devices, 2013, Springer
- Dietl, Awschalom, Kaminska, Ohno, Spintronics, 2008, Academic Press
- Blachowicz, Ehrmann, Spintronics, 2019, de Gruyter
- Tsymbal, Zutic, Spintronics Handbook, Volume One: Metallic Spintronics, 2019, CRC Press
- Xu, Awschalom, Nitta, Handbook of Spintronics, 2016, Springer

Courses Course nr. **Course name** 18-me-2020-vl Introduction to Spintronics Instructor Type SWS Prof. Dr. rer. nat. Markus Meinert Lecture 3 Course nr. Course name 18-me-2020-ue Introduction to Spintronics Instructor Туре SWS Prof. Dr. rer. nat. Markus Meinert Practice 1

Mo Rot	dule name oust Data Scie	nce With Biomedical	Applications			
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-:	mu-2010	6 CP	180 h	120 h	1 Term	Winter term
Lan Eng	glish			Module owner Prof. DrIng. Mic	hael Muma	
1	1 Teaching content Robust Data Science for Signal Processing • Basics on robust statistical learning • Basics on robust statistical learning • Robust regression models • Robust clustering and classification • Robust time-series and spectral analysis • High-dimensional robust data science Biomedical Applications • Body-worn and radar-based sensing of vital signs • Body-worn and radar-based sensing of vital signs • Electrocardiogram (ECG) and Photoplethysmogram (PPG) • Biomarker selection • Eye research • Genomics • Intracranial Pressure (ICP) The lecture covers fundamental topics and recent developments in robust data science. Unlike classical statistical learning and signal processing, which relies strongly on the normal (Gaussian) distribution, robust methods can tolerate impulsive noise, outliers and artifacts that are frequently encountered in biomedical applications. Robust data science and biomedical application lectures alternate. Exercises revise the theory and apply robust machine learning and signal processing algorithms to real world data. Software toolboxes in Python, Matlab and R that implement the lecture contents are available to the students.					
2	Learning of Students un variety of pr outliers and spectral ana	ojectives derstand the basics coblems. They are fa impulsive noise. The lysis.	of robust signal p miliar with variou y can apply algori	rocessing and data is biomedical appli thms for robust reg	science and are abl cations and know th ression, cluster analy	e to apply them to a le causes of artifacts, sis, classification and
3	Recomment Fundamenta	ded prerequisites fo al knowledge of statis	or participation stical signal proces	ssing		
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	xamination, Exam	ination, Duration:	180 Min., Default RS	5)
5	Prerequisite Pass module	e for the award of c	redit points			
6	Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)					
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. M	edTec, M.Sc. iCE, N	M.Sc. etit - VAS	
8	Grade bonu	s compliant to §25	(2)			
9	References					

A manuscript and lecture slides can be downloaded via Moodle. Further reading

- Zoubir, A. M. and Koivunen, V. and Ollila, E. and Muma, M.: Robust Statistics for Signal Processing. Cambridge University Press, 2018.
- Zoubir, A. M. and Koivunen, V. and Chackchoukh J, and Muma, M. Robust Estimation in Signal Processing: A Tutorial-Style Treatment of Fundamental Concepts. IEEE Signal Proc. Mag. Vol. 29, No. 4, 2012, pp. 61-80.
- Huber, P. J. and Ronchetti, E. M.: Robust Statistics. Wiley Series in Probability and Statistics, 2009.
- Maronna, R. A. and Martin, R. D. and Yohai, V. J.: Robust Statistics: Theory and Methods. Wiley Series in Probability and Statistics, 2006.

Courses

Course nr. 18-mu-2010-vl	Course name Robust Signal Processing With Biomedical Applications		
Instructor		Type	SWS
Prof. DrIng. Michael Muma		Lecture	3
Course nr. 18-mu-2010-ue	Course name Robust Data Science With Biomedical Applications		
Instructor		Type	SWS
Prof. DrIng. Michael Muma		Practice	1

Mo Info	dule name ormation Theor	y II: Networks					
Mo 18-	Module nr.Credit pointsWorkloadSelf-studyModule durationModule cycle18-pe-20106 CP180 h120 h1 TermSummer term						cle erm
Lar Eng	iguage glish		100 11	Module owner Prof. DrIng. Ma	rius Pesavento		
1	Teaching contentThis lecture course is devoted to topics in network information theory. Outline: overview of Shannon capacity, outage and ergodic capacity, capacity of channels with state, capacity of Gaussian vector channels, capacity regions of multi-user channels, capacity regions of multiple-access and broadcast fading channels, interference channel, relay channel, multiuser bounds, graphical multi-hop networks, routing, network coding, capacity of MIMO multiple-access and broadcast channels, duality of MIMO multiple access and broadcast channels, dirty paper coding, multi-user diversity, wiretap channel, secrecy rate and physical layer security.						
2	Learning object Upon complet network infor	ectives on of the module, mation theory.	students will have	an understanding o	of the advanced of	concepts and strat	tegies in
3	Recommende Knowledge of	d prerequisites fo basic communicati	or participation				
4	Form of exam Module exam • Module The examinat students regist be announced	ination exam (Technical ex ion takes place in f er, the examination in the beginning o	xamination, Oral/ form of a written e n will be an oral ex of the lecture.	written examinatio exam (duration: 12 camination (duratio	n, Duration: 120 0 minutes). If a n: 20 min.). The) Min., Default R oparent that less type of examinat	S) than 10 tion will
5	Prerequisite Passing the fir	For the award of c al module examin	redit points ation				
6	Grading Module exam: • Module	exam (Technical e	xamination, Oral/	written examinatio	n, Weighting: 10	00 %)	
7	Usability of t M.Sc. WI-etit,	ne module M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E, B.Sc. und M.Sc.	iST, M.Sc. etit -	CMEE, M.Sc. etit	t - VAS
8	Grade bonus	compliant to §25	(2)				
9	References						
	 Abbas El Gamal and Young-Han Kim, Network Information Theory, Cambrige, 2011. T.M. Cover and J.A. Thomas, Elements of Information Theory, Wiley Sons, 1991. D. Tse and P. Vishwanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005. 						
Cot	urses						
	Course nr. 18-pe-2010-vl	Course name Information T	heory II: Network	S			1
	InstructorTypeSWSProf. DrIng. Marius PesaventoLecture3						

	Course nr. 18-pe-2010-ue	Course name Information Theory II: Networks		
	Instructor Prof. DrIng. Ma	rius Pesavento	Type Practice	SWS 1

Mo Coi	Module name Convex Optimization in Signal Processing and Communications					
Module nr.		Credit points	Workload	Self-study	Module duration	Module cycle
18- Lot	pe-2020	6 CP	180 h	120 n Modulo owner	1 Ierm	Summer term
Eng	glish			Prof. DrIng. Mai	rius Pesavento	
1	1 Teaching content This graduate course introduces the basic theory of convex optimization and illustrates its use with many recen applications in communication systems and signal processing. Outline: Introduction, convex sets and convex functions, convex problems and classes of convex problems (LP, QF SOCP, SDP, GP), Lagrange duality and KKT conditions, basics of numerical algorithms and interior point methods optimization tools, convex inner and outer approximations for non convex problems, sparse optimization distributed optimization, discrete optimization, mixted integer linear and non-linear programming, Branch-and Bound method, Branch-and-Cut method, customized iterative optimization, Newton method, gradient projection method, conjugate gradient method, block coordinate descent method, successive convex approximation method BSUM method, Majorization Maximization, difference-of-convex procedure, ADMM, step size selection, optima					
2	Learning of After comple This includes and mobile	pjectives ting the module, stud s in particular the bas communication syste	lents will have bec sic theory of conve ms.	ome familiar with a x optimization and	dvanced topics in mo its application in dig	dern communication. ital signal processing
3	Recomment Knowledge i	ded prerequisites fo n linear algebra and	or participation the basic concept	s of signal processi	ng and communication	ons.
4	Form of exa Module exar • Modul The examin less than 14 examination	mination n: e exam (Technical ex ation takes place in students register, th will be announced i	amination, Oral/ form of a writter le examination wi n the beginning o	written examinatio 1 exam (duration: 1l be an oral exam f the lecture.	n, Duration: 120 Mir 120 minutes). If or ination (duration: 20	n., Default RS) ne can estimate that 0 min.). The type of
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exan • Modul	n: e exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of M.Sc. WI-et CMEE, M.Sc	the module it, M.Sc. CE, M.Sc. e . etit - VAS	tit - KTS, M.Sc. iC	E, B.Ed. etit, B.Sc.	und M.Sc. iST, B.Sc	. WI-etit, M.Sc. etit -
8	Grade bonus compliant to §25 (2)					
9 Со	 9 References S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004. (online Verfügbar: http://www.stanford.edu/ boyd/cvxbook/) D. P. Bertsekas, Nonlinear Programming, Athena Scientific, Belmont, Massachusetts, 2nd Ed., 1999. Daniel P. Palomar and Yonina C. Eldar, Convex Optimization in Signal Processing and Communications, Cambridge University Press, 2009. 					

Course nr. 18-pe-2020-vl	Course name Convex Optimization in Signal Processing and Communications			
Instructor Prof. DrIng. Ma	rius Pesavento	Type Lecture	SWS 2	
Course nr. 18-pe-2020-ue	Course name Convex Optimization in Signal Processing and Communications			
Instructor Prof. DrIng. Marius Pesavento		Type Practice	SWS 1	
Course nr. 18-pe-2020-pr	Course name Convex Optimization in Signal Processing and Communications Lab			
Instructor Prof. DrIng. Marius Pesavento		Type Lab	SWS 1	

Mo	dule name	. 1.1.1				
Sen	sor Array Pro	cessing and Adaptive	Beamforming		Madula dunation	Madula anala
18-	dule nr. pe-2060	4 CP	120 h	Self-study 75 h	1 Term	Summer term
Lar	191129e		120 11	Module owner	1 101111	building term
Eng	glish			Prof. DrIng. Mai	rius Pesavento	
1	ITeaching contentThis lecture course introduces the principles of modern sensor array processing and adaptive beamforming. Outline: Motivation and background; applications, narrowband and wideband signal model Direction-of-arrival estimation (DoA): traditional methods based on beamforming, super resolution methods, Maximum-Likelihood methods, Subspace based methods, MUSIC, ESPRIT, MODE, root-MUSIC, multidimensional source localization, approximate Maxi- mum Likelihood methods, Expectation Maximization (EM) algorithm, partial relaxation method, beamspace processing, array interpolation, partly calibrated arrays, wideband DOA estimation, spatial smoothing, forward- 					
2	Learning of Upon comple Sensor-Arry	ojectives etion of the module, st and Tensor data	tudents will have le	earned the applicati	on of theory and algo	rithms for processing
3	Recomment Knowledge i	ded prerequisites fo in linear algebra.	or participation			
4	Form of exa Module exam • Modul The examin less than 10 examination	mination n: e exam (Technical ex ation takes place in students register, th will be announced i	kamination, Oral/ form of a writter he examination wi n the beginning o	written examinatio n exam (duration: ill be an oral exam f the lecture.	n, Duration: 120 Mir 120 minutes). If or ination (duration: 20	n., Default RS) ne can estimate that 0 min.). The type of
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	 6 Grading Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %))
7	7 Usability of the module M.Sc. MEC, M.Sc. etit - SAE, M.Sc. WI-etit, M.Sc. etit - KTS, M.Sc. iCE, B.Sc. und M.Sc. iST, B.Sc. WI-etit, M.Sc etit - VAS					, B.Sc. WI-etit, M.Sc.
8	Grade bonu	s compliant to §25	(2)			
9	References					

- 1. Academic Press Library in Signal Processing: Volume 3 Array and Statistical Signal Processing Edited by Rama Chellappa and Sergios Theodoridis, Section 2, Edited by Mats Viberg, Pages 457-967 (2014) a) Chapter 12 - Adaptive and Robust Beamforming, Sergiy A. Vorobyov, Pages 503-552
 - b) Chapter 14 DOA Estimation Methods and Algorithms, Pei-Jung Chung, Mats Viberg, Jia Yu, Pages
 - 599-650 c) Chapter 15 - Subspace Methods and Exploitation of Special Array Structures, Martin Haardt, Marius
 - Pesavento, Florian Roemer, Mohammed Nabil El Korso, Pages 651-717
- 2. Spectral Analysis of Signals, Petre Stoica, Randolph Moses, Prentice Hall, April 2005Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory, Harry L. Van Trees, Wiley Online, 2002.

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CO	Courses						
	Course nr. 18-pe-2060-vl	nr.Course name.060-vlSensor Array Processing and Adaptive Beamforming					
	Instructor Prof. DrIng. Marius Pesavento		Type Lecture	SWS 2			
	Course nr. 18-pe-2060-ue	Course name Sensor Array Processing and Adaptive Beamforming					
Instructor Prof. DrIng. Marius Pesavento		rius Pesavento	Type Practice	SWS 1			

Mo Ma	Module name Matrix Analysis and Computations						
Mo 18-	dule nr. pe-2070	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration 1 Term	Module cycle Summer term	
Lan Eng	iguage dish			Module owner Prof. DrIng. Ma	rius Pesavento		
1	1 Teaching content This graduate course is a foundation class on matrix analysis and computations, which are widely used in many different fields, e.g., machine learning, computer vision, systems and control, signal and image processing, communications, networks, optimization, and many more Apart from the theory this course will also cover the design of efficient algorithm and it considers many different examples from the aforementioned fields including examples from social media and big data analysis, image processing and medical imaging, communication network optimization, and written text classification. Specific topics: (i) basic matrix concepts, subspace, norms, (ii) linear least squares (iii) eigendecomposition, singular value decomposition, positive semidenite matrices, (iv) linear system of equations, LU decomposition, Cholesky decomposition (v) pseudo-inverse, QR decomposition (vi) advanced tensor decomposition, advanced matrix calculus compressive sensing structured matrix factorization						
2	Learning of Students wil completion of	jectives l have learned advan of the module.	ced topics in matr	ix analysis and rela	ated algorithms at an	advanced level upon	
3	Recommend Basic knowle	led prerequisites fo edge in linear algebra	or participation a.				
4	Form of exa Module exar • Modul The examination examination	mination n: e exam (Technical ex ation takes place in students register, th will be announced i	amination, Oral/ form of a writter he examination wi n the beginning o	written examination exam (duration: ill be an oral exam f the lecture.	on, Duration: 120 Mir 120 minutes). If or ination (duration: 20	n., Default RS) ne can estimate that 0 min.). The type of	
5	Prerequisite Pass module	e for the award of c final exam.	redit points				
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %))	
7	Usability of B.Sc. etit, M iST, B.Sc. W	the module Sc. MEC, M.Sc. WI I-etit, M.Sc. etit - CM	-etit, M.Sc. etit - H IEE	KTS, M.Sc. etit - AU	JT, M.Sc. iCE, B.Ed.	etit, B.Sc. und M.Sc.	
8	Grade bonu	s compliant to §25	(2)				
9	References						

- Gene H. Golub and Charles F. van Loan, Matrix Computations (Fourth Edition), John Hopkins University Press, 2013.
- Roger A. Horn and Charles R. Johnson, Matrix Analysis (Second Edition), Cambridge University Press, 2012.
- Jan R. Magnus and Heinz Neudecker, Matrix Differential Calculus with Applications in Statistics and Econometrics (Third Edition), John Wiley and Sons, New York, 2007.
- Giuseppe Calaore and Laurent El Ghaoui, Optimization Models, Cambridge University Press, 2014.
- ECE 712 Course Notes by Prof. Jim Reilly, McMaster University, Canada (friendly notes for engineers) http://www.ece.mcmaster.ca/faculty/reilly/ece712/course_notes.htm

Courses

60	41303					
	Course nr. 18-pe-2070-vl	Course name Matrix Analysis and Computations				
	Instructor Prof. DrIng. Marius Pesavento		Type Lecture	SWS 3		
	Course nr.Course name18-pe-2070-ueMatrix Analysis and Computations					
	Instructor Prof. DrIng. Marius Pesavento		Type Practice	SWS 1		

Mo Gra	dule name	cessing. Learning an	d Optimization			
Module nr. Credit points Workload Self-study Module duration Module cyc						Module cycle
18-	pe-2080	6 CP	180 h	120 h	1 Term	Winter term
Lar				Module owner		
Eng	glish			Prof. DrIng. Mai	rius Pesavento	
1	Teaching co	ontent				
	The course of	covers the following t	copics:			
	Motiva	ation, Applications				
	• Funda	mentals	lasses of graphs r	properties of graphs	signals defined over	or granhs
	– A	djecency matrix, Gra	ph Laplacian, Gra	ph shift operator	, signals defined ove	a grupiis
	– C	ovariance matrix, co	nditional depende	ence, precision mat	rix	
	 Graph 	signal processing				
	- C	onsensus, Diffusion		- 6		
	– G	raph spectral analysi	s, Graph Fourier	Fransform		
	- I	otal variational norm	i, Graph Frequenc	ies		
	- D - G	raph filters Graph sig	ampling theorem			
	– A	pplications				
	• Netwo	ork topology inference	e			
	– L	ink prediction				
	– A	ssociation network in	nference			
	– T	omographic network	topology inference	ce		
	– P	earson product-mom	ent correlation			
	- 0	onditional independe	ence graph			
	– G	aussian Markov Ran	dom Fields			
	– G	raphical LASSO, Gra	phical LASSO with	n Laplacian constra	int	
	– A	pplications	•			
	• Graph	analysis				
	– S	ubgraph identificatio	n			
	– C	liques identification				
	• Optim	verage consensus di	ffusion exact diff	usion		
	– G	radient tracking, pus	sh-sum algorithm.	etc.		
	– A	pplications				
	• Graph	neuronal (convolutio	onal) network			
2	Learning ol	ojectives				
Graph signal processing (i.e., the processing of signals defined over graphs) and network analysis for						ork analysis form an
	interdiscipli	hary research field wi	th numerous and c	liverse applications.	Upon completion of	the module, students
	learning on	timization in graph ne	euge III graph Sigi	ing using graph per	y, graph network and iral networks. They b	uysis, graph topology
	concepts. al	gorithms and applica	tion areas of gran	h signal processing		iave icarricu Costrillal
ર	Recommen	ded prerequisites fo	r narticination		·	
5	Basic knowl	edge in linear algebr	a and matrix analy	vsis.		
	basic knowledge in inical algebra and matrix analysis.					

4 Form of examination

	 Module exam: Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS) In general, the examination takes place in form of a written exam (duration: 120 minutes). If up to 20 students register in semesters in which the lecture does not take place, there will will be an oral examination (duration: 20 min.). The type of examination will be announced within one working weeks after the end of the examination registration phase. 					
5	Prerequisite for Passing the final	the award of credit points module examination				
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 					
7	Usability of the M.Sc. WI-etit, M M.Sc. etit - VAS	module .Sc. CE, M.Sc. etit - KTS, M.Sc. MedTec, M.Sc. iCE, B.Sc. und	d M.Sc. iST, M.Sc. etit -	CMEE,		
8	Grade bonus co	mpliant to §25 (2)				
9	References					
	 Lecture notes and slides can be downloaded here: www.nts.tu-darmstadt.de moodle Further reading: Petar M. Djuric, Cédric Richard, Cooperative and Graph Signal Processing, Academic Press, 2018, ISBN 9780128136775. 					
Co	urses					
	Course nr.Course name18-pe-2080-vlGraph signal processing, learning and optimization					
	InstructorTypeSWSProf. DrIng. Marius PesaventoLecture3					
	Course nr. 18-pe-2080-ue	Course name Graph signal processing, learning and optimization				
	Instructor Prof. DrIng. Ma	rius Pesavento, M.Sc. Yufan Fan	Type Practice	SWS 1		

Mo Ter	dule name ahertz System	and Applications					
Module nr.Credit pointsWorkloadSelf-studyModule durationModule duration18-pr-20104 CP120 h75 h1 TermSun				Module cycle			
Lan	nguage glish		120 11	Module owner Prof. Dr. rer. nat.	Sascha Preu	Summer term	
1	1 Teaching content The lecture will give an overview of Terahertz applications, sources and detectors with the focus on photonic and semiconductor-based devices and Terahertz systems. Terahertz detection and generation will be discussed in detail for two types of highly important devices: Schottky diodes (mixers, multi-pliers and rectifiers) and photomixers (photo-diode based and photoconductive). The exercise, where performance parameters of the discussed devices will be derived for experimentally relevant cases, will help to deepen the understanding. The last day will be used for a lab tour showing our measurements facilities and hands-on Experiments.						
2	Learning of After complete systems, and • A gene • Workin • Workin • THz A	ojectives etion of this module, th d applications of THz eral overview about th ng principle, spectra a ng principle of Schott pplications	ne student has gain radiation, with de he state of the art and limits of conti ky diode mixers/m	ned basic knowledg eepened knowledg in Terahertz techn inuous-wave photo multipliers and rec	e in the fields of THz g e in: ology mixer systems tifiers in the THz ran	generation, detection, ge	
3	Recommen Bachelor in Helpful: Bas	ded prerequisites fo Electrical engineering ic knowledge in semi	r participation g, Physics, or Mate iconductor physic	erial Science s, High frequency 1			
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 20 students register, the examination will be an oral examination (duration: 25 min.). The type of examination 						
5	Prerequisite • Pass modu	e for the award of cı ıle final exam	redit points				
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 						
7	Usability of M.Sc. WI-et	t he module it, M.Sc. CE, M.Sc. et	tit - KTS, M.Sc. iC	E			
8	Grade bonus compliant to §25 (2)						
9 Co	References • Yun-Shik Lee, "Principles of Terahertz Science and Technology," Springer 2009, ISBN 978-0-387-09540-0 • G. Carpintero et al., "Semiconductor Terahertz Technology: Devices and Systems at Room Temperature Operation," Wiley 2015, ISBN: 978-1-118-92042-8						
Course nr. 18-pr-2010-vl	Course nr.Course name18-pr-2010-vlTerahertz Systems and Applications						
------------------------------------	----------------------------------------------------------------------	-------------	------------	--	--		
Instructor		Type	SWS				
Prof. Dr. rer. nat. Sascha Preu		Lecture	2				
Course nr. 18-pr-2010-ue	Course name Terahertz Systems and Applications		·				
Instructor		Type	SWS				
Prof. Dr. rer. nat. Sascha Preu		Practice	1				

Mo Mo	Module name Modelling and Simulation of Circuits						
Mo	dule nr. sc-2010	Credit points	Workload 120 h	Self-study 75 h	Module duration	Module cycle	
Lar Ger	nguage man/English		120 11	Module owner Prof. Dr. rer. nat.	Sebastian Schöps		
1	Teaching content The content of this course is the following: • Circuit interpretation as directed graphs • Modified nodal and loop analysis • Flux and charge oriented formulations • Differential algebraic equations • Linear system solver • Numerical solution of nonlinear systems • Time-domain methods • Frequency-domain solution • Implementation of the numerical methods						
2	Learning objectives Students understand the theoretical and numerical fundamentals of circuit simulation and how the equations can be derived from Maxwell's equations. Circuit properties can be expressed in tems of graph theory. The sparse systems of equations such as the flux/charge oreinted modified nodal analysis can be assembled. In order to solve the obtained systems, different numerical methods for the simulation of circuits are relevant. This includes methods for the solution of linear systems (direct and iterative solvers), root-finding algorithms for nonlinear systems and implicit time integration methods. Mathematical concepts such as stability, convergence order or complexity are known and can be employed to judge the advantages and disadvantages of the various methods. Eventually, the students are able to programm their own circuit simulator, that can return both frequency as well						
3	Recommen 18-hs-1070 20-00-0304	ded prerequisites fo Elektrotechnik und I Allgemeine Informati	or participation informationstechr k I, 04-10-0602 St	ik I, 18-gt-1020 El atistics/Probability	ektrotechnik und Int Theory, 04-10-0603	formationstechnik II, Scientific Computing	
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	camination, Oral e	examination, Durat	ion: 20 Min., Defaul	t RS)	
5	Prerequisite Passing the	e for the award of c	redit points				
6	 Grading Module exam: Module exam (Technical examination, Oral examination, Weighting: 100 %) 						
7	Usability of the module B.Sc. etit, M.Sc. WI-etit, M.Sc. CE, M.Sc. iCE, B.Sc. und M.Sc. iST, B.Sc. WI-etit, M.Sc. etit - CMEE				it - CMEE		
8	Grade bonu Grade bonu	as compliant to §25 s of 0,4 if correctly in	(2) nplemented progr	ams are submitted			
9	References						

- L. W. Nagel, "SPICE2: A computer program to simulate semiconductor circuits", University of Berkeley, Tech. Rep., 1975.
- C.-W. Ho, A. E. Ruehli, and P. A. Brennan, "The modified nodal approach to network analysis", IEEE Trans. Circ. Syst., vol. 22, no. 6, pp. 504-509, Jun. 1975.
- J. Vlach, K. Singhal, Computer methods for circuit analysis and design. New York : Van Nostrand Reinold, 1983.

Courses

uu	ourses					
	Course nr. 18-sc-2010-vl	Course name Modelling and simulation of circuits				
	Instructor		Type Lecture	SWS 2		
	Course nr. 18-sc-2010-ue	Course name Modelling and simulation of circuits				
	Instructor		Type Practice	SWS 1		

Mo Sim	dule name ulation of Mult	iphysics Problems					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy Winter terr	cle
Lan Eng	iguage Ilish		100 11	Module owner Prof. Dr. rer. nat.	Sebastian Schöps	whiter term	
1	Teaching content The course covers multiphysical and cross-domain modeling of differential-algebraic systems, e.g. consisting of electrical, electronic, mechanical, hydraulic, thermal, control, or process-oriented components, as well as the coupling of spatially distributed and lumped or integrated components. Concepts of model analysis, simulation methods and their implementation are taught						isting of ll as the nulation
2	Learning obj The students them by comp interpreted ar	ectives know the individua onents. They can a ad explained. Stude	al physical models nalyze the problen ents can assess the	s, can combine the ns and simulate the e possibilities and l	m to multiphysical n m on their own. Sim imitations of multiph	nodels and re ulation results sysics simulat	present s can be ions.
3	Recommende Scientific Com	ed prerequisites for aputing, Introduction	or participation on to physical mod	leling			
4	Form of exam Module exam • Module The examinati 30 students re will be annou	nination : exam (Technical ex on takes place in for gister, the examina nced in the beginn	xamination, Oral/ orm of a written ex ation will be an ora ing of the lecture.	written examinatic am (duration: 90 n al examination (dur	on, Duration: 90 Min ninutes). If one can e ration: 25 min.). The	., Default RS) stimate that le type of exam) ess than nination
5	Prerequisite Passing the fir	for the award of c nal module examin	redit points ation				
6	Grading Module exam • Module	: exam (Technical e:	xamination, Oral/	written examinatio	on, Weighting: 100 %	b)	
7	Usability of t M.Sc. CE, M.S	he module Sc. etit - CMEE					
8	Grade bonus Yes. An earne	compliant to §25 d bonus is creditab	(2) le until the exercis	se is offered again.			
9	References Will be hande	d out during the le	cture and is provi	ded via Moodle.			
Cot	ırses						
	Course nr.Course name18-sc-2030-vlSimulation of Multiphysics Problems						
	InstructorTypeSWSProf. Dr. rer. nat. Sebastian SchöpsLecture2					SWS 2	
	Course nr. 18-sc-2030-ue	Course name Simulation of	Multiphysics Prob	lems			
	Instructor Prof. Dr. rer. r	at. Sebastian Schö	ops		Type Practice		SWS 2

Mo Fas	Module name Fast Boundary Element Methods for Engineers						
Mo	dule nr. sc-2040	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration	Module cycle	
Lar Eng	iguage Ilish		100 11	Module owner Prof. Dr. rer. nat.	Sebastian Schöps		
1	1Teaching contentHow to solve field problems numerically on the computer? The Boundary Element Method (BEM) has developedinto an important alternative to domain-oriented approaches (like Finite Elements), ever since fast implementations are available. The BEM reduces the dimensionality of the problem and can easily take into accountunbounded domains. Starting from the representation formulas of Kirchhoff and Stratton-Chu boundary integralequations are derived. Next, their discretization by collocation and Galerkin methods is discussed. The resultingfully populated matrices have to be compressed for practical applications, by Fast Multipole or Adaptive CrossApproximation methods. Practical examples for application of the BEM are considered, for instance acoustic andelectromagnetic scattering problems, and thermal analysis. Programming homework will be assigned, to deepenthe students' understanding of the contents						
2	 2 Learning objectives Students will acquire a detailed understanding of Modeling and Simulation with BEM. Derivation: convert certain types of partial differential equations to boundary integral equations Discretization: obtain boundary element methods from boundary integral equations Compression: efficiently store and solve the resulting linear systems of equations Application: solve practical field problems in engineering, in the acoustic, electromagnetic and thermal domains 						
3	Recommen Basic knowl Basic knowl electromagn	ded prerequisites fo edge about numerical edge about modelling netic domain: Maxwe	or participation methods for the so and simulation in ll's equations; the	olution of partial di an application dom rmal domain: heat	fferential equations (e ain (e.g., acoustic dor equation).	e.g., Finite Elements). nain: wave equation;	
4	Form of exa Module exa • Modu The examin 30 students will be anno	amination m: le exam (Technical ex ation takes place in fo register, the examina ounced in the beginni	amination, Oral/ rm of a written ex tion will be an ora ng of the lecture.	written examinatio am (duration: 90 n ıl examination (duı	n, Duration: 90 Min. iinutes). If one can es ration: 25 min.). The	, Default RS) stimate that less than type of examination	
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation				
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %))	
7	Usability of M.Sc. MEC,	f the module M.Sc. CE					
8	Grade bon	is compliant to §25	(2)				
9	 References Will be handed out during the lecture and is provided via Moodle. 						
Coi	Courses						

Course nr. 18-sc-2040-vl	Course nr.Course name8-sc-2040-vlFast Boundary Element Methods for Engineers					
Instructor		Type	SWS			
Prof. Dr. rer. nat. Sebastian Schöps, Dr. Felix Wolf		Lecture	2			
Course nr. 18-sc-2040-ue	Course name Fast Boundary Element Methods for Engineers					
Instructor		Type	SWS			
Prof. Dr. rer. nat. Sebastian Schöps, Dr. Felix Wolf		Practice	2			

Mo Inti	Introduction to Scientific Computing in C++					
Mo 18-	dule nr. sc-2050	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration	Module cycle Winter term
Lar	nguage			Module owner		
Eng	glish			Prof. Dr. rer. nat.	Sebastian Schöps	
1	1 Teaching content Students with basic programming experience will get an introduction to computational programming of numerical algorithms in C++. The first half of this course will focus on basics of the programming language C++, and highlight aspects in which the language differs from scripting languages such as Python or Matlab. Subsequently, the focus of the course will be on efficient memory management: We discuss modern best practices such as the usage of reference types and idioms like RAII ("Resource Acquisition is Initialization") rather than classical pointers ("Raw-Pointers"). During the exercises, we illustrate the effect of memory handling for numerical linear algebra applications, and introduce STL (Standard Template Library) data structures in this context. In the second half of the lecture, the students implement more complex algorithms from different application areas using the "Eigen" library (for linear algebra) and openMP (for parallel computing). Here, the focus lies on understanding both libraries, improving the students' programming level from the first lecture half, and solving programming tasks from different areas such as stochastics, numerical solution of differential equations, and approximations.					
2	Learning of Students wi Basics Differe Data t Workin Data t Memo	bjectives Il obtain a basic under of C++ (Syntax, der ences to Python / Ma ypes for numerical ag rn C++ (Templates, ng with CMake and C ypes of STL and "Eig ry management, per	erstanding for the velopment environ ttlab (types, classe pplication (e.g. flo RAII, Lambdas, Git gen", and the devel formance benchm	implementation of ments, compilatio s, pointers, referen at, double, Unum/2 .) according to sta lopment of numeric arks, parallelization	numerical algorithm n,) ces,) Posit, HDF,) ndard >= 11 cal software on their n with openMP	ns in C++ including: basis
3	Recommen	ded prerequisites fo	or participation			
	EssentMathe lation	tials of programming matik I - IV, in partic problems, numerics	in Python / Matla ular: Linear algeb of ordinary differe	ıb ra, numerical soluti ential equations	on of systems of linea	ar equations, interpo-
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 30 students register, the examination will be an oral examination (duration: 25 min.). The type of examination will be announced in the beginning of the lecture. 					
5	Prerequisit Passing the	e for the award of c final module examination	redit points ation			
6	Grading Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)					
7	Usability of M.Sc. etit -	f the module DT, M.Sc. WI-etit, B.	Sc. und M.Sc. iST	, M.Sc. etit - CMEE		

8	Grade bonus compliant to §25 (2) Yes. An earned bonus is creditable until the exercises are offered again.					
9	References Will be handed out during the lecture and is provided via Moodle.					
Co	urses					
	Course nr.Course name18-sc-2050-vlIntroduction to Scientific Computing in C++					
	Instructor Dr. Manuel Baun	ann, Dr. Felix Wolf	Type Lecture	SWS 2		
	Course nr. 18-sc-2050-ue	Course name Introduction to Scientific Computing in C++				
	Instructor		Type Practice	SWS 2		

Mo Cor	dule name	Networks II				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18- Lar	sm-2010	6 CP	180 h	120 n Module owner	1 Ierm	winter term
Eng	glish			Prof. DrIng. Ral	f Steinmetz	
1	English Prof. DrIng. Ralf Steinmetz 1 Teaching content The course Communication Networks II covers the principles and practice of computer networking and telecommunications with emphasis on the Internet. Starting with the history, the course discusses past, current and future aspects of communication networks. In addition to the basics including well known protocols and technologies, recent developments in the area of multimedia communication (e.g., Video Streaming, P2P, IP-Telephony, Cloud Computing and Service-oriented Architectures) will be examined thoroughly. The course is designed as follow-up to Communication Networks I. Topics are: • Basics and History of Communication Networks (Telegraphy vs. Telephony, Reference Models,) • Transport Layer (Addressing, Flow Control, Connection Management, Error Detection, Congestion Control,) • Transport Protocols (TCP, SCTP) • Interactive Protocols (TCP, SCTP) <td< th=""></td<>					
2	Learning ol Upon success of computer course discu well known Video Streas thoroughly.	bjectives sful completion, the networking and tele sses past, current and protocols and technoming, P2P, IP-Teleph The course is design	module provides s communications d future aspects of ologies, recent de ony, Cloud Comp ed as follow-up to	tudents with an un with emphasis on t communication net velopments in the uting and Service-c Communication N	derstanding of the pr he Internet. Starting works. In addition to area of multimedia o priented Architecture etworks I.	rinciples and practice with the history, the o the basics including communication (e.g., es) will be examined
3	Recomment Basic course Networks I i strengthene	ded prerequisites fo es of first 4 semesters s recommended. The d in practical program	or participation are required. Kno coretical knowledg mming exercises.	owledge in the topi e obtained in the c So, basic programm	cs covered by the cor ourse Communication ning skills are benefic	urse Communication n Networks II will be cial.
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 120 Min., Default RS) 					
5	 Prerequisite for the award of credit points Passing the final module examination 					
6	 6 Grading Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %) 					
7	Usability of	the module				

	M.Sc. MEC. M.Sc. etit - DT. M.Sc. WI-etit, M.Sc. CE. B.Sc. CE, M.Sc. MedTec. M.Sc. iCE, M.Sc. iST, B.Ed. etit						
8	 Grade bonus compliant to §25 (2) The maximum grade improvement is 1.0. For a grade improvement to be awarded, a minimum number of points (50% of the maximum achievable points) must be reached. From this minimum number, the grade improvement increases proportionally (from 0.0 grade improvement at the minimum number to a maximum of 1.0 grade improvement from 95% of the maximum achievable points). Above 95% of the maximum achievable points, the bonus is 1.0. 						
9	References Selected chapters from following books: • Andrew S. Tanenbaum: Computer Networks, Fourth 5th Edition, Prentice Hall, 2010 • James F. Kurose, Keith Ross: Computer Networking: A Top-Down Approach, 6th Edition, Addison-Wesley, 2009 • Larry Peterson, Bruce Davie: Computer Networks, 5th Edition, Elsevier Science, 2011						
Coi	ırses						
	Course nr. 18-sm-2010-vl	Course name Communication Networks II					
	InstructorTypeSWSDrIng. Tobias Meuser, M.Sc. Christoph Gärtner, M.Sc. Pratyush Agnihotri, Prof.Lecture3DrIng. Ralf SteinmetzSteinmetz3						
	Course nr.	Course name					

18-sm-2010-ue Communication Networks II		
Instructor DrIng. Tobias Meuser, M.Sc. Christoph Gärtner, M.Sc. Pratyush Agnihotri, Pr DrIng. Ralf Steinmetz	rof. Type Practice	SWS 1

Mo Mu	Module name Multimedia Communications Project II						
Mo 18-	dule nr. sm-2130	Credit points 9 CP	Workload 270 h	Self-study 180 h	Module duration	Module cycle Every Semester	
Lar Ger	nguage man/English			Module owner Prof. DrIng. Ral	f Steinmetz		
1	German/English Prof. DrIng. Ralf Steinmetz 1 Teaching content The course deals with cutting edge scientific and development topics in the area of multimedia communication systems. Besides a general overview it provides a deep insight into a special scientific topic. The topics are selected according to the specific working areas of the participating researchers and convey technical and scientific competences in one or more of the following topics: Network planning and traffic analysis Performance evaluation of network applications Discrete event simulation for networks services Protocols for mobile ad hoc networks / sensor networks Infrastructure networks for mobile communication / mesh networks Context-aware communication and services Peer-to-peer systems and architectures Content distribution and management systems for multimedia / e-learning Multimedia authoring and re-authoring tools Web service technologies and service-oriented architectures Resource-based Learning 						
2	 2 Learning objectives The ability to solve and evaluate technical and scientific problems in the area of design and development future multimedia communication networks and applications using state of the art scientific methods shall be acquired. Acquired competences are: Searching and reading of project relevant literature Design of complex communication applications and protocols Implementing and testing of software components for distributed systems Application of object-oriented analysis and design techniques Acquisition of project management techniques for small development teams Systematic evaluation and analyzing of technical and scientific experiments Writing of software documentation and project reports Presentation of project advances and outcomes 						
3	 Recommended prerequisites for participation Keen interest to develop and explore challenging solutions and applications in cutting edge multimedia communications systems using scientific methods. Further we expect: Solid experience in programming Java and/or C# (C/C++). Solid knowledge in object oriented analysis and design. Basic knowledge of design patterns, refactoring and project management. Solid knowledge in computer communication networks is recommended. Lectures in "Communication Networks I" and "Communication Networks II" are recommended 					e multimedia commu-	
4	 Form of examination Module exam: 						

5	Prerequisite for Passing the final	the award of credit points module examination			
6	Grading Module exam: • Module exa	um (Study achievement, Oral/written examination, Weighting	: 100 %)		
7	Usability of the module M.Sc. iCE, B.Sc. und M.Sc. iST				
8	Grade bonus compliant to §25 (2)				
9	 References Each topic is covered by a selection of papers and articles. In addition we recommend reading of selected chapters from following books: Andrew Tanenbaum: "Computer Networks". Prentice Hall PTR (ISBN 0130384887) Raj Jain: "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling" (ISBN 0-471-50336-3) Joshua Bloch: "Effective Java - Programming Language Guide" (ISBN-13: 978-0201310054) Erich Gamma, Richard Helm, Ralph E. Johnson: "Design Patterns: Objects of Reusable Object Oriented Software" (ISBN 0-201-63361-2) Martin Fowler: "Refactorings - Improving the Design of Existing Code" (ISBN-13: 978-0321278654) 				
Co	ırses				
	Course nr. 18-sm-2130-pr	Course name Multimedia Communications Project Lab			
	InstructorTypeSWProf. Dr. rer. nat. Björn Scheuermann, Dr. Ing. Julian Zobel, M.Sc. FridolinLab6				

Мо	dule name							
Sof	tware Defined	Networking		1	1		1	
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
18-	sm-2280	6 C P	180 h	Modulo owner				
Ger	iguage man/English			Module owner Prof Dr-Ing Balf Steinmetz				
1	 1 Teaching content The course deals with topics in the area of software defined networking: SDN Data Plane SDN Control Plane SDN Application Plane Network Function Virtualization Network Virtualization and Slicing QoS and QoE in Software Defined Networks 							
2	Learning objectives Upon completion of the module, students will have gained in-depth insights into Software Defined Networking, as well as basic technologies and applications.							
3	Recommended prerequisites for participation Basic courses of the first 4 semesters are required. Knowledge of lectures Communication Networks I and II are recommended.							
4	Form of exa Module exar • Modul The examina 15 students will be anno	mination n: e exam (Technical e: tion takes place in fo register, the examina unced in the beginn	xamination, Oral/ orm of a written ex tion will be an ora ing of the lecture.	written examinatic am (duration: 90 n al examination (du	on, Duratior ninutes). If ration: 20 n	1: 90 Min. one can es nin.). The	, Default RS) stimate that le type of exam	ess than nination
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exar • Modul	n: e exam (Technical e:	xamination, Oral/	written examinatio	on, Weightir	ng: 100 %)	
7	Usability of M.Sc. etit - I	the module DT, M.Sc. WI-etit, M	.Sc. CE, B.Sc. CE,	M.Sc. iCE, B.Sc. u	nd M.Sc. iS	Т		
8	Grade bonu	s compliant to §25	(2)					
9	9 References Textbooks as indicated. Slides and paper copies as necessary.							
Coι	ırses							
	Course nr. 18-sm-2280-	vl Software Defin	ned Networking					1
	Instructor DrIng. Ralf	Kundel, M.Ed. Benj	amin Becker, M.So	. Chengbo Zhou		Type Lecture		SWS 2

Course nr. 18-sm-2280-ue	Course name Software Defined Networking		
Instructor DrIng. Ralf Kun	del, M.Ed. Benjamin Becker, M.Sc. Chengbo Zhou	Type Practice	SWS 2

Mo	dule name							
Tra	nsport Protoco	ols and their Design						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	uration	Module cy	cle
18-	sm-2320	6 CP	180 h	105 h	1 Term		Irregular	
Ger	i guage man			Prof. Dr. rer. nat.	Björn Sche	uermann		
1	1 Teaching content This module covers in-depth knowlege about transport protocols and related aspects. We will consider robustness, ease of implementation, efficiency, performance and reliability. Of particular interest will be how to model the protocol behavior and the interplay of transport protocols with other layers of the Internet protocol stack. The focus will be on the Transmission Control Protocol (TCP) and its variants.							
2	2 Learning objectives After taking this module, students understand the protocol mechanisms of the transport layer in detail, including their interplay within the layer and with other protocol layers. They can use this knowledge to predict and evaluate the effects of protocol modifications. To this end, they are able to analyze the behavior of transport protocols and to assess the impact of key parameters including latency, bandwidth and buffer size on the suitability of different design variants.							
3	Recommended prerequisites for participation Basic knowledge in the field of communication networks, as covered for instance in the module "Kommunika- tionsnetze 1".							
4	Form of exam Module exam • Module The examination examination	mination n: e exam (Technical ex ation takes place in students register, th will be announced i	amination, Oral/ form of a writter he examination wi n the beginning o	written examinatio 1 exam (duration: ill be an oral exam f the lecture.	n, Duration 120 minut ination (du	n: 120 Mir res). If on aration: 30	n., Default RS le can estima) min.). The	5) ate that type of
5	Prerequisite Passing the f	for the award of cannot be for the award of cannot be a second statement of the second statement of th	redit points ation					
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weightin	ng: 100 %)	
7	Usability of M.Sc. etit - D	the module T, M.Sc. WI-etit, M.	Sc. CE, M.Sc. etit	- KTS, B.Sc. CE, B	.Sc. und M.	Sc. iST, M	I.Sc. etit - VA	S
8	Grade bonu s Yes	s compliant to §25	(2)					
9	References Technical lite	erature will be ment	ioned in the lectu	re.				
Coi	ırses							
	Course nr. 18-sm-2320-	vl Course name Transport Prot	ocols and their De	esign				
	Instructor Prof. Dr. rer.	nat. Björn Scheuern	nann			Type Lecture		SWS 3
	Course nr. 18-sm-2320-	ue Transport Prot	ocols and their De	esign				
	It is an 2020 at a manipole riotocols and then Design Instructor Type SWS Prof. Dr. rer. nat. Biorn Scheuermann Practice 2					SWS 2		

Mo Apr	Module name Application-Laver Protocols on the Internet							
Mo 18-	dule nr. sm-2330	Credit points 6 CP	Workload 180 h	Self-study 105 h	Module du 1 Term	uration	Module cyo Irregular	cle
Lar Ger	iguage man	I	I	Module owner Prof. Dr. rer. nat.	Björn Sche	uermann		
1	Teaching co The module Internet. Th to-peer syste the skills to	ontent covers in-depth know is includes widely us ems, blockchains, etc. design and implement	vledge on applicat ed client-server p .). The focus is on nt efficient and eff	ion architectures a cotocols like HTTP tradeoffs between fective protocols or	nd application as well as d design alter n the applica	on-layer p istributed matives a ntion layer	protocols used architecture nd the acquis r.	l on the s (peer- sition of
2	Learning of After taking poses. They They can ap protocol me	ojectives this module, students understand the desig ply this knowledge chanisms for practica	s understand the k gn space and are a to design and ana ally relevant desig	ey questions that the able to recognize an alyze protocol design n problems.	ne design of nd avoid cor gns, and the	an applic nmon prc ey are abl	ation-layer pr oblems and m le to design s	rotocols nistakes. suitable
3	Recommended prerequisites for participation Basic knowledge in the field of communication networks, as covered for instance in the module "Communication Networks I".							
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS) The examination takes place in form of an oral examination (duration: 30 minutes). If one can estimate that more than 30 students register, the examination will be a written exam (duration: 120 min.). The type of examination will be announced in the beginning of the lecture 							
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical ex	xamination, Oral/	written examinatio	n, Weightin	g: 100 %)	
7	Usability of M.Sc. etit - l	the module DT, M.Sc. WI-etit, M.	.Sc. CE, M.Sc. etit	- KTS, B.Sc. CE, B	.Sc. und M.	Sc. iST, M	I.Sc. etit - VA	S
8	Grade bonu Announceme to accompar	s compliant to §25 ents will be made at t by the lecture that wi	(2) he beginning of the ill improve grades	e semester as to wh	ether there	will be ho	mework assig	nments
9	References Technical lit	erature will be ment	ioned in the cours	e.				
Cot	ırses							
	Course nr. 18-sm-2330	-vl Application-La	yer Protocols on t	he Internet				1
	Instructor Prof. Dr. rer.	nat. Björn Scheuern	nann			Type Lecture		SWS 3
	Course nr. 18-sm-2330	-ue Application-La	yer Protocols on t	he Internet				
	Instructor Type SWS Prof. Dr. rer. nat. Biörn Scheuermann Practice 2					SWS 2		

Mo Res	Module name Resilient Communication Networks							
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18-	sm-2340	4 CP	120 h	75 h	1 Term	Summer term		
Lar	iguage			Module owner				
Eng	glish			Prof. Dr. rer. nat.	Björn Scheuermann			
1	 The course covers the following topics: Resilience in the different disciplines Resilience in communication networks Importance of resilience for communication networks Requirements for current communication networks Methods to increase resilience in communication networks Wireless networks (e.g., mobile communications) Wired networks Resilient network management in software-defined networks Resilience through adaptivity in software-defined networks 							
2	Learning objectives Students are familiar with the idea and necessity of resilience in various disciplines with a focus on adaptive communication networks. They are familiar with various methods for increasing resilience, such as redundancy and diversity, and can apply these methods to the design of communication networks.							
3	Recomment	ded prerequisites fo	or participation					
4	Form of exa Module exar • Modul The examina 10 students will be anno	mination n: e exam (Technical ex ation takes place in f register, the examina unced in the beginni	kamination, Oral/ form of a written e tion will be an ora ing of the lecture.	written examinatio exam (duration: 90 al examination (du	n, Duration: 90 Min. min.). If one can estration: 30 min.) The	, Default RS) timate that less than type of examination		
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %)		
7	Usability of M.Sc. etit - I VAS	the module DT, M.Sc. WI-etit, M.	.Sc. CE, M.Sc. etit	- KTS, B.Sc. CE, M	Sc. iCE, B.Sc. und M	Л.Sc. iST, M.Sc. etit -		
8	Grade bonus compliant to §25 (2) Grade improvements up to 0.4 according to APB 25(2) through bonus for regularly completed and submitted bonus exercises.							
9	References							

A lecture notes or slides can be downloaded:

Moodle Platform

Advanced literature

- Smith, Paul, et al. "Network resilience: a systematic approach." IEEE Communications Magazine 49.7 (2011): 88-97
- Sterbenz, James PG, et al. "Resilience and survivability in communication networks: Strategies, principles, and survey of disciplines." Computer networks 54.8 (2010): 1245-1265
- Mauthe, Andreas, et. al. "Disaster-resilient communication networks: Principles and best practices." 2016 8th International Workshop on Resilient Networks Design and Modeling (RNDM). IEEE, 2016

Courses

00	11303			
	Course nr.	Course name		
	Instructor		Туре	SWS
	Prof. Dr. rer. nat.	Björn Scheuermann, DrIng. Tobias Meuser	Lecture	2
	Course nr.	Course name		
	18-sm-2340-ue	Resilient Communication Networks		
	Instructor		Туре	SWS
	Prof. Dr. rer. nat.	Björn Scheuermann, DrIng. Tobias Meuser	Practice	1

Mo	dule name	ng and Forwarding						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	uration	Module cyc	cle
Lan	nguage	0 CP	180 11	Module owner	1 Ierm		Irregular	
Ger	man			Prof. Dr. rer. nat.	Björn Sche	uermann		
1	Teaching co The Modul of types of network and switchin robustness, network laye in part consi	ontent overs in-depth knowl works and different r ng data and for pacl stability and efficier er are also considered st of group exercise	edge about the ne equirements we co ket forwarding. T ncy, also in terms , for instance firew lab blocks.	twork layer and rel onsider methods for he focus is on que of the interplay w vall technologies or	ated aspects routing, for stions of pro- ith other la BGP security	s of the lin r the repro otocol de oyers. Sec y. The acc	lk layer. For d esentation of sign with res curity aspects ompanying ex	lifferent routing spect to s of the xercises
2	2 Learning objectives After taking this module, students understand the design options for routing in networks and the efficient implementation of packet forwarding in detail. They can use this knowledge to assess the effects of protocol design decisions and to analyze the expected and actual behavior of protocol designs, individually and in comparison.							
3	Recommended prerequisites for participation Basic knowledge in the field of communication networks, as covered for instance in the module "Communication Networks I".							
4	Form of exa Module exar • Modul The examina enroll, the ex will be anno	mination n: e exam (Technical ex ation is an oral exam xamination can also unced at the beginni	xamination, Oral/ ination (duration: take the form of a ing of the course.	written examinatio 30 min.). If it is fo written exam (dura	n, Duration reseeable th ation: 120 m	: 120 Mir aat more t nin.). The	n., Default RS han 30 stude type of exam	5) ents will nination
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical ez	xamination, Oral/	written examinatio	n, Weightin	ıg: 100 %)	
7	Usability of M.Sc. etit - I	the module DT, M.Sc. WI-etit, M	.Sc. CE, M.Sc. etit	- KTS, B.Sc. CE, B	.Sc. und M.	Sc. iST, M	I.Sc. etit - VA	S
8	Grade bonu Announceme to accompar	s compliant to §25 ents will be made at t by the lecture that w	(2) he beginning of the ill improve grades	e semester as to wh	ether there v	will be ho	mework assig	nments
9	References Technical lit	erature will be ment	ioned in the cours					
Co ι	urses							
	Course nr. 18-sm-2350	Course namevlRouting, Swite	ching and Forward	ling				
	Instructor Prof. Dr. rer.	nat. Björn Scheuerr	nann			Type Lecture		SWS 3

	Course nr. 18-sm-2350-ue	Course name Routing, Switching and Forwarding		
	Instructor Prof. Dr. rer. nat.	Björn Scheuermann	Type Practice	SWS 2

Mo Ene	dule name ergy Managen	nent and Optimizatio	on			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Eng	iguage glish	0 CP	180 II	Module owner Prof. Dr. rer. nat.	Florian Steinke	Summer term
1	1 Teaching content The lecture reviews the different levels of energy management. It then focuses on economic dispatch and discusses its different use cases like optimization of self-consumption, virtual power plants, electric vehicle load management or multi-modal neighborhood optimization. Relevant knowledge about the components to be controlled as well as the markets to be addressed is explained. After this introduction to economic dispatch's application environment, the lecture focuses on the methods employed. The underlying mathematical formulations as different types of optimization problems (LP, MILP, QP, stochastic optimization) are reviewed. In parallel, a practical introduction to numerical optimization is given (descent algorithms, convergence, convexity, programming languages for the formulation of optimization problems). Moreover, an introduction into simple methods for the prognosis of future values (linear regression) is provided. All methodological learning is accompanied by hands-on exercises using Python and the mathematical modeling language GAMS.					
2	Learning objectives Students know the different use cases and formulations of economic dispatch. They have a basic understanding of the typically employed optimization methods and are able to judge the quality of the achieved results. Moreover, students are independently able to formulate (energy) optimization problems and solve them with Python and GAMS.					
3	Recommen Standard kr is required.	ded prerequisites fo lowledge of linear alg Knowledge of the mo	or participation gebra and multivar odules "Kraftwerko	iate analysis as we e & EE" or "Energie	ll as basic knowledge wirtschaft" is helpfu	in the use of Python l but not necessary.
4	Form of exa Module exa • Modul The examina 8 students r will be anno	amination m: le exam (Technical ex ation takes place in fo egister, the examinat punced in the beginni	kamination, Oral/ orm of a written ex ion will be an ora ng of the lecture.	written examinatio am (duration: 90 n l examination (dur	n, Duration: 90 Min ninutes). If one can es ation: 25 min.). The	., Default RS) stimate that less than type of examination
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exa • Modul	m: le exam (Technical ex	kamination, Oral/ [,]	written examinatio	n, Weighting: 100 %))
7	Usability of M.Sc. etit - WI-etit, M.S	the module DT, M.Sc. ESE, M.S c. etit - CMEE	c. etit - EET, M.S	c. WI-etit, M.Sc. C	E, B.Ed. etit, B.Sc.	und M.Sc. iST, B.Sc.
8	 Grade bonus compliant to §25 (2) Improvement of grades up to 0.4 compliant to APB 25(2) through bonus system for re-gular attention of exercises and practical courses 					attention of exercises
9	References					

- Boyd, Vandenberghe: Convex Optimization, Cambridge University Press, 2004
- A GAMS Tutorial by Richard E. Rosenthal https://www.gams.com/24.8/docs/userguides/userguide/_u_g__tutorial.html

Courses Course nr. Course name 18-st-2010-vl Energy Management and Optimization SWS Instructor Туре Prof. Dr. rer. nat. Florian Steinke, M.Sc. Sina Hajikazemi Lecture 2 Course name Course nr. 18-st-2010-ue Energy Management and Optimization SWS Instructor Туре Prof. Dr. rer. nat. Florian Steinke, M.Sc. Sina Hajikazemi Practice 1 Course nr. Course name 18-st-2010-pr Energy Management and Optimization Lab Instructor Туре SWS Prof. Dr. rer. nat. Florian Steinke, M.Sc. Sina Hajikazemi Lab 1

Mo	dule name							
Ma	chine Learnin	g & Energy				1		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lar	0112020	0 CF	100 11	Module owner	1 101111	Every 2. Semester		
Eng	glish			Prof. Dr. rer. nat. Florian Steinke				
1	 The analysis and interpretation of data becomes ever more important, also for engineers. Digitalization and Smart Grids are terms to describe a host of novel data-based services in the field of generation, distribution, consumption, and marketing of (renewable) energy. The lecture presents the recent developments and their underlying machine learning methods. For a start we describe the different problem settings of machine learning methods, review recent developments in the field, and evaluate the impact of machine learning on the energy sector. After such an introductory overview, we review the basics of linear algebra and numerical optimization. We then introduce supervised learning problems and study different model classes to solve such problems (linear models, trees, random forests, nearest neighbor, kernel methods, deep learning). We then turn to a probabilistic view and study unsupervised learning problems. Finally, we give an introduction to probabilistic graphical models. Throughout the semester we discuss exemplary applications of machine learning in the energy domain (e.g. renewable forecasting, predictive maintenance, state estimation, probabilistic load flow). Practical exercises with Python deepen the understanding and support students' actively usable skills. 							
2	Learning objectives Students understand important machine learning problem settings and some key methods for each task. They know common applications thereof in the energy domain. Moreover, the students are able to apply and adapt those methods independently to new applications (not only from the energy domain).							
3	Recommended prerequisites for participation • Good knowledge of linear algebra required • Basic knowledge of statistics and numerical optimization will be helpful • Using Python for programming the practical examples should pose no difficulty							
4	Form of exa Module exam- • Modul The examina 8 students r will be anno	mination m: e exam (Technical ex ation takes place in fo egister, the examinat ounced in the beginn	xamination, Oral/ orm of a written ex ion will be an ora ing of the lecture.	written examinatio am (duration: 90 n l examination (dur	n, Duration: 90 Min. ninutes). If one can es ation: 25 min.). The	, Default RS) stimate that less than type of examination		
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)							
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, B.Sc. u	nd M.Sc. iST					
8	Grade bonu Notenverbes /Praktikums	is compliant to §25 sserungen bis zu stermine und mindes	(2) 0,4 nach APB tens einmaliges V	25(2) durch Bon orrechnen in den Ü	us für regelmäßig bungen	besuchte Übungs-		
9	References							

- K.P. Murphy: Machine Learning. A Probabilistic Perspective.
 C.M. Bishop: Pattern Recognition & Machine Learning
 J. Friedman, T. Hastie, R. Tibshirani: The elements of statistical learning
 D. Koller, N. Friedmann: Probabilistic Graphical Models. Principles and Techniques

Co	urses			
	Course nr. 18-st-2020-vl	Course name Machine Learning & Energy		
	Instructor Prof. Dr. rer. nat.	Florian Steinke, M.Sc. Benedikt Grüger, M.Sc. Andrei Eliseev	Type Lecture	SWS 2
	Course nr. 18-st-2020-ue	Course name Machine Learning & Energy		
	Instructor Prof. Dr. rer. nat.	Florian Steinke, M.Sc. Benedikt Grüger, M.Sc. Andrei Eliseev	Type Practice	SWS 1
	Course nr. 18-st-2020-pr	Course name Machine Learning & Energy Lab		
	Instructor Prof. Dr. rer. nat.	Florian Steinke, M.Sc. Benedikt Grüger, M.Sc. Andrei Eliseev	Type Lab	SWS 1

Mo	Module name					
Tec	hnology and I	Economics of Multim	odal Energy Syste	ms	N7 1.1. 1	No. 1.11.
18-	aule nr. st-2060	Credit points 5 CP	workload 150 h	Seif-study 105 h	1 Term	Summer term
Lar			100 11	Module owner		
Ger	man/English			Prof. DrIng. Ste	fan Nießen	
1	1 Teaching content Energy economical framework, structures of multimodal energy systems, investment and costing, energy trading, sources for flexibility including storage, regulation, sustainability, social acceptance and stakeholder interests Topics of good scientific practice, as well as societal or ethical aspects of product design, optimization, and algorithms are addressed in an accompanying manner, where technically appropriate.					
2	 2 Learning objectives The students learn the structures of energy supply systems including electricity, primary energies, heating, cooling, transport and water desalination. They understand the underlying principles for the design of energy systems for buildings, sites, cities and countries and are able to assess their adequacy for different international locations considering costs, environmental impact and social acceptance. The students learn to assess the economic viability of investments in energy asssets using new present value and annuity. They learn the functionning of energy markets and different forms of trading and settlement for energy transactions 					
	Based on an technology of storage and hydrogen ar and industri Energy syste that define th The regulation origins and	analysis of the impa of different sources f for the coupling of di ind inertia. Multimod al processes. Ems are subject to nu- ne regulatory framewors ons are the result of s impact of public opin	act of an increasin for flexbility inclu fferent modes of e al coupling techno merous laws and n ork such as feed-in societal processes. ion and the perce	g share of renewal ding demand-side nergy. Storage tech ologies include pov regulations. Theref tarifs, tax incentive Therefore, the stud ption of risk.	bles in the system, th -management, differ nologies include batt ver-heat, heat-coolin ore, the students lear s, credit programs, qu lents analyze the diffe	e students learn the rent technologies for eries, pumped hydro, g, power-heat-water rn different elements totas and certificates. erent interest groups,
3	Recommend A completed tronics, envi	ded prerequisites fo Bachelor in any of t ronmental sciences,	or participation he following subje business administ	ects: electrical engination/engineering	neering, mechanical ((Wirtschaftsingenie)	engi-neering, mecha- urwesen)
4	Form of exa Module exar • Modul In general, t the exam is after the end	mination n: e exam (Technical ex he module is examinoral (duration: 30 mi d of the exam applica	xamination, Oral/ ned by written exa (n.). The mode of ntion phase.	written examination mination (duration examination will be	n, Duration: 120 Min n: 120 min.). If 20 st e communicated with	n., Default RS) cudents or less apply, in one working week
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %))
7	Usability of M.Sc. ESE, M	t he module M.Sc. etit - EET, M.Sc	c. WI-etit			
8	Grade bonu Grade impro	s compliant to §25	(2) ccessful presentation	ion during the sem	inar	
9	References					

- Downloadable slides
- Book.energytransition.org/en
 https://www.agora-energiewende.de/fileadmin2/Projekte/2018/A_word_on/Agora_Energiewende_a-word-on_flexibility_WEB.pdf

Co	Courses						
	Course nr. 18-st-2060-vl	Course name Technology and Economics of Multimodal Energy Systems					
	Instructor Prof. DrIng. Ste	fan Nießen	Type Lecture	SWS 2			
	Course nr. 18-st-2060-se	Course name Technology and Economics of Multimodal Energy Systems - s	simulation game				
	InstructorTypeSWSProf. DrIng. Stefan NießenSeminar1						

Mo Des	dule name	nergiewende				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Ger	nguage rman	6 CP	180 h	Module owner Prof. DrIng. Stet	fan Nießen	winter term
1	1 Teaching content Current studies on the energy transition will be analyzed and discussed. Based on a computer simulation (simulation game energy transition), interdisciplinary teams will have to make independent decisions on the political-legal framework, the expansion of the energy system and its operation. In fast motion from 2020 to 2050, the consequences of the decisions for CO2 balance, costs and security of supply will be experienced. For this purpose, the roles of electricity producers, industry, private households and politics will be assumed. Topics of good scientific practice, as well as social or ethical aspects of product design, optimization and algorithms will be addressed where technically appropriate					
2	 2 Learning objectives The students know different methods for techo-economical analysis of energy systems and base parameters of energy systems. Furthermore they have an overview on main technologies for energy conversion and storage today and possible future evolutions. They also comprehend governance basics consisting in EU legal acts, German laws and directives and an overview on the institutions implementing these 					
3	Recommen A completed tronics, env Elektrotechi	ded prerequisites fo l Bachelor in any of t ironmental sciences, nik und Informations	r participation he following subje business adminis technik), Political	ects: electrical engi stration/electrical e Sciences	neering, mechanical engineering (Wirtsch	engineering, mecha- aaftsingenieurwesen-
4	Form of exa Module exa • Modul Report (inclu- and/or Colle	amination m: le exam (Study achie uding submission of p oquium (testate). The	vement, Oral/wrig rogramming code e type of examina	tten examination, I) and/or Presentati tion will be annou	Default RS) on and/or Oral exam nced in the beginning	ination (25 minutes) g of the lecture.
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation			
6	Grading Module exa • Modul	m: le exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit		
8	Grade bonu	is compliant to §25	(2)			
9	 References Downloadable slides Book.energytransition.org/en https://www.agora-energiewende.de/fileadmin2/Projekte/2018/A_word_on/Agora_Energiewende_a-word-on_flexibility_WEB.pdf 					
C01	Courses					

Course nr. 18-st-2080-vl	Course name Designing the Energiewende - lecture			
Instructor Prof. Dr. rer. nat. Stefan Nießen	Florian Steinke, Prof. Dr. phil. Michèle Knodt, Prof. DrIng.	Type Lecture	SWS 1	
Course nr. 18-st-2080-pr				
Instructor Prof. Dr. rer. nat. Stefan Nießen	Florian Steinke, Prof. Dr. phil. Michèle Knodt, Prof. DrIng.	Type Lab	SWS 1	
Course nr. 18-st-2080-se	Course name Designing the Energiewende - seminar			
InstructorTypeProf. Dr. rer. nat. Florian Steinke, Prof. Dr. phil. Michèle Knodt, Prof. DrIng.SeminarStefan NießenSeminar				

Mo Sof	dule name	ering - Maintenance	and Quality Assu	rance			
Mo	dule nr. $311-2010$	Credit points	Workload	Self-study	Module durat	tion Module cy	cle
Lan	nguage man	0.01	100 11	Module owner Prof. Dr. rer. nat.	Andreas Schür	r	
1	1 Teaching content The lecture covers advanced topics in the software engineering field that deal with maintenance and quality assurance of software. Therefore, those areas of the software engineering body of knowledge which are not addressed by the preceding introductory lecture, are in focus. The main topics of interest are: software maintenance and reengineering, configuration management, static programme analysis and metrics, dynamic programme analysis and runtime testing as well as programme transformations (refactoring). During the exercises, the participants analyze, test and restructure different examples.						
2	Learning of The lecture u in a practice activities ne software con	jectives uses a single running -oriented style. Upo eded to maintain ar figuration managem	example to teach on successful com nd evolve a softw nent and testing ac	basic software mai pletion of the mod are system of cons ctivities. Selection a	ntenance and q ule, students sl iderable size. and usage of CA	uality assuring tec hould be familiar Main emphasis is SE tool play a maj	hniques with all laid on jor role.
3	Recomment Introduction	led prerequisites for to Computer Scienc	or participation e for Engineers as	well as basic know	ledge of Java		
4	Form of exa Module exar • Module	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Defaul	t RS)	
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exar • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	c. WI-etit, M.Sc. C	E, B.Sc. CE, M.Sc.	MedTec, M.Sc.	iST, M.Sc. etit - C	MEE
8	Grade bonu	s compliant to §25	(2)				
9	References https://www	v.es.tu-darmstadt.de,	/lehre/aktuelle-ve	eranstaltungen/se-i	i-v and Moodle		
Coι	ırses	I					
	Course nr.Course name18-su-2010-vlSoftware-Engineering - Maintenance and Quality Assurance						
	InstructorTypeSWSProf. Dr. rer. nat. Andreas Schürr, M.Sc. Isabelle BacherLecture3						SWS 3
	Course nr. 18-su-2010-1	Course name Le Software-Engi	neering - Mainten	ance and Quality A	Assurance		
	Instructor Prof. Dr. rer.	nat. Andreas Schürn	r, M.Sc. Isabelle Ba	acher	Typ Prac	e ctice	SWS 1

Mo Rea	dule name l-Time Syster	ns				
Mo	dule nr. su-2020	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration	Module cycle
Lar Ger	nguage man		100 11	Module owner Prof. Dr. rer. nat.	Andreas Schürr	
1	1 Teaching content The lecture basically covers a model-driven software engineering process which is specially customized for real-time systems. This process is more deeply explored in the exercise using an automotive example. A focus is laid on object-oriented techniques. In this context, a real-time specific state-of-the-art CASE tool is introduced and used. Furthermore, fundamental characteristics of real-time systems and system architectures are introduced. Scheduling algorithms are discussed to get insights into real-time operating systems. Finally, a comparison between the Java programming language and its expansion for real-time operating systems (RT Java) will conclude the lecture.					
2	 Learning objectives After successful completion of the module, students are able to use and evaluate model-based (object-oriented) techniques for the development of embedded real-time systems. This includes a deeper understanding of the following topics:					
3	Recommen Basic knowl programmir	ded prerequisites fo edge of software eng ng language (preferal	or participation gineering techniqu bly Java)	ues and excellent k	nowledge of at least	one object-oriented
4	Form of exa Module exam • Modul The examina 15 students will be anno	amination m: e exam (Technical ex ation takes place in fo register, the examina ounced in the beginni	kamination, Oral/ orm of a written ex tion will be an ora ing of the lecture.	written examinatio am (duration: 90 n ll examination (dur	n, Duration: 90 Min. hinutes). If one can es ration: 30 min.). The	, Default RS) stimate that less than type of examination
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %))
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	c. WI-etit, M.Sc. C	E, B.Sc. CE, M.Sc.	iCE, M.Sc. iST, B.Sc.	und M.Sc. iST
8	Grade bonus compliant to §25 (2) Grade improvements up to 0.4 per APB 25 (2) due to bonus for regularly submitted homework tasks					ework tasks
9	References https://www	w.es.tu-darmstadt.de,	/lehre/aktuelle-ve	eranstaltungen/es-v	v and Moodle	
Cou	Courses					

Course nr. 18-su-2020-vl	Course nr.Course name18-su-2020-vlReal-Time Systems			
Instructor Prof. Dr. rer. nat.	Instructor Prof. Dr. rer. nat. Andreas Schürr		SWS 3	
Course nr. 18-su-2020-ue	Course name Real-Time Systems			
Instructor M.Sc. Hendrik G	öttmann, Prof. Dr. rer. nat. Andreas Schürr	Type Practice	SWS 1	

Mo Ada	Module name Adaptive Filters						
Mo 18-	dule nr. zo-2010	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration 1 Term	Module cycle Summer term	
Lar Ger	nguage man/English	1		Module owner Prof. DrIng. Abc	lelhak Zoubir		
1	Teaching co Theory:	ontent					
	 Derivation of optimal filters for stochastic processes, e.g. Wiener filter or linear prediction filter based on suitable cost functions. Elaboration of adaptive procedures, which allow to iteratively approach the optimal solution for non-stationary signals in non-stationary environments. Here, the adaptive procedures such as NLMS adaptation, affine projection, and the RLS algorithm are derived and extensively analysed. Analysis of the adaptation behaviour and control procedures of adaptive filters based on the NLMS procedure. Derivation and analysis of the Kalman filter as optimal filter for non-stationary input signals. Procedures for the decomposition of signals into sub-bands for the realization of optimal filters in the frequency domain, e.g. noise reduction procedures. Applications: Parallel to the theory, practical applications are explained. As an example for the Weiner filter, the acoustic noise reduction procedures are explained. Acoustic echo cancellation and feedback cancellation are given as examples for adaptive filters. Furthermore beamforming approaches are introduced. It is planned to offer an excursion to Siemens Audiology Engineering Group in Erlangen. In the 4 to 5 exercises some content of the lecture will be implemented in MATLAB which allows the students to 						
2	Learning of Upon compl algorithms a the content For the admi will allow yo unknown to life as an en	pjectives letion of the module are derived, interpret of the lecture you are ission to the exam yoo ou to acquire the know pic and present your gineer.	e, students were t ted and applied to e able to apply ada u give a talk about w-how to read and knowledge, such	aught the fundam examples of speed aptive filters to real t a topic in the dom l understand scient as it will be certain	entals of adaptive fil h, audio and video p practical application ain of adaptive filters ific literature, familia ly required from you	Iters. The necessary processing. Based on as. chosen by you. This rize yourself with an in your professional	
3	Recomment Digital Signa	ded prerequisites fo al Processing	or participation				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Duration: 90 Min., Default RS) The examination takes place in form of a written exam (duration: 90 minutes). If one can estimate that less than 21 students register, the examination will be an oral examination (duration: 20 min.). The type of examination will be announced in the beginning of the lecture 					, Default RS) stimate that less than type of examination	
5	Prerequisite Passing the f	e for the award of c	redit points				
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %))	
7	Usability of	the module					

	M.Sc. WI-etit, M	M.Sc. WI-etit, M.Sc. CE, M.Sc. etit - KTS, M.Sc. iCE, B.Sc. und M.Sc. iST, M.Sc. etit - VAS					
8	Grade bonus co	mpliant to §25 (2)					
9	References Slides of the lecture. Literature: • E. Hänsler, G. Schmidt: Acoustic Echo and Noise Control, Wiley, 2004 (Textbook of this course); • S. Haykin: Adaptive Filter Theory, Prentice Hall, 2002; • A. Sayed: Fundamentals of Adaptive Filtering, Wiley, 2004; • P. Vary, U. Heute, W. Hess: Digitale Sprachsignalverarbeitung, Teubner, 1998 (in German)						
CO	Course nr. 18-zo-2010-vl	Course name Adaptive Filters					
	Instructor Prof. DrIng. He	nning Puder	Type Lecture	SWS 3			
	Course nr.Course name18-zo-2010-ueAdaptive Filters						
	Instructor Prof. DrIng. He	nning Puder	Type Practice	SWS 1			

Mo Dig	dule name ital Signal Pro	cessing						
Mo 18-	dule nr. zo-2060	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module 1 Term	duration	Module cyc Winter tern	cle n
Lar Eng	iguage glish			Module owner Prof. DrIng. Abc	lelhak Zou	ıbir	I	
1	 Teaching content Discrete-Time Signals and Linear Systems - Sampling and Reconstruction of Analog Signals Digital Filter Design - Filter Design Principles; Linear Phase Filters; Finite Impulse Response Filters; Infinite Impulse Response Filters; Implementations Digital Spectral Analysis - Random Signals; Nonparametric Methods for Spectrum Estimation; Parametric Spectrum Estimation; Applications; 					Infinite ametric		
2	Learning ob Students und Furthermore the basics of analyze them	ectives lerstand basic princ they are able to an spectral estimation with respect to the	ciples of signal pr alyze statistical si and can design n eir performance.	ocessing. They car gnals in the time ar on-parametric as w	n design a nd frequen rell as para	nd analyze acy domain ametric spe	e FIR and IIF . The student ctral estimate	<pre>{ filters. ts know ors and</pre>
3	Recommend Deterministic	ed prerequisites for signals and system	or participation as theory					
4	Form of exam Module exam • Module	nination u: exam (Technical e:	xamination, Exam	ination, Duration:	180 Min.,	Default RS)	
5	Prerequisite Passing the fi	for the award of c nal module examin	r edit points ation					
6	Grading Module exam • Module	i: exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MEC, M.Sc. iST, M	t he module M.Sc. etit - SAE, M Sc. etit - VAS	.Sc. WI-etit, M.Sc	. CE, M.Sc. etit - K	TS, M.Sc.	MedTec, N	Л.Sc. iCE, В.S	Sc. und
8	Grade bonus	compliant to §25	(2)					
9	 9 References Course manuscript Additional References: A. Oppenheim, W. Schafer: Discrete-time Signal Processing, 2nd ed. J.F. Böhme: Stochastische Signale, Teubner Studienbücher, 1998 							
Cot	urses	Course name						
	18-zo-2060-v	1 Digital Signal	Processing					
	Instructor Prof. DrIng.	Abdelhak Zoubir, M	.Sc. Christian Schi	oth, M.Sc. Christia	n Eckrich	Type Lecture		SWS 3

Course nr. 18-zo-2060-ue	Course name Digital Signal Processing		
Instructor Prof. DrIng. Abc	lelhak Zoubir, M.Sc. Christian Schroth, M.Sc. Christian Eckrich	Type Practice	SWS 1

Mo Spe	Module name Speech and Audio Signal Processing						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
Lar	nguage rman	0.61	100 11	Module owner Prof. DrIng. Abc	lelhak Zoubir	winter term	
1	1 Teaching content Algorithms of speech and audio signal processing: Introduction to the models of speech and audio signals and basic methods of audio signal processing. Procedures of codebook based processing and audio coding. Beamforming for spatial filtering and noise reduction for spectral filtering. Cepstral filtering and fundamental frequency estimation. Mel-filterind cepstral coefficients (MFCCs) as basis for speaker detection and speech recognition. Classification methods based on GMM (Gaussian mixture models) and speech recognition with HMM (Hidden markov models). Introduction to the methods of music signal processing, e.g. Shazam-App or beat detection.						
2	Learning of Based on th help of the processing, such as they (MMI). The and audio p familiarize v your profess	bjectives le module you acquir analysis of speech sig to range from the th are applied in mobile exercise will be org- rocessing. This will a with an unknown top sional life as an engin	e an advanced kn gnals. You learn a leory to practical e telephones, hear anized as a talk g llow you to acquin ic and present you leer.	owledge of digital bout different basi applications. You v ing aids, hands-free iven by each stude re the know-how to r knowledge, such a	audio signal process c and advanced met vill acquire knowled e telephones, and ma nt with one self-sele read and understand as it will be certainly	sing mainly with the hods of audio signal ge about algorithms n-machine-interfaces ected topic of speech d scientific literature, required from you in	
3	Recommen Knowlegde - but not ma	ded prerequisites fo about satistical signa indatory - is knowled	or participation l processing (lectu ge about adaptive	ıre "Digital Signal I filters.	Processing"). Desired	l	
4	Form of exa Module exa • Modul Seminar pre (duration 10 exam (dura	amination m: le exam (Technical ex esentation: Scientific)-15 min) or in group tion 90 min)	kamination, Oral⁄ talk about a topic s of two students	written examinatio in the field of "Spe (15-20 min) or in a	n, Duration: 90 Min. eech and Audio Signa group of 20 student	., Default RS) al Processing", single s and more a written	
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation				
6	 6 Grading Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)))	
7	7 Usability of the module M.Sc. etit - SAE, M.Sc. WI-etit, M.Sc. CE, M.Sc. etit - KTS, M.Sc. MedTec, M.Sc. iCE, B.Sc. und M.Sc. iST					. und M.Sc. iST	
8	8 Grade bonus compliant to §25 (2)						
9	References Slides (for f	urther details see ho	mepage of the lect	cure)			
Co	urses		. .				
Course nr. 18-zo-2070-vl	Course name Speech and Audio Signal Processing						
---------------------------------------	----------------------------------------------------------	-------------------------	-----------------	--			
Instructor Prof. DrIng. Her	Type Lecture	SWS 2					
Course nr. 18-zo-2070-ue	Course name Speech and Audio Signal Processing						
Instructor Prof. DrIng. Her	nning Puder	Type Practice	SWS 1				
Course nr. 18-zo-2070-se	Course name Sprach- und Audiosignalverareitung						
Instructor Prof. DrIng. Her	nning Puder	Type Seminar	SWS 1				

Mo Dat	dule name ta Science I						
Mo 18-	dule nr. zo-2110	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration	Module cycle Summer term	
Lar Eng	1guage glish	1	I	Module owner Prof. DrIng. Abc	Module owner Prof. DrIng. Abdelhak Zoubir		
1 Teaching content The course covers the following topics: • Python programming basics • Data science introduction • Data storage and formats • Data exploration and visualization • Statistical methods and inference • Inferential statistics • Feature extraction • Image data • Audio data • Statistical learning • Classification							
2	Learning ol This module knowledge a to visualizat	o jectives offers an introduction about all parts of a Da ion.	n to the topic of D ata Science process	ata Science with a s sing: From storage/	strong practical orien /data acquisition over	tation. Students gain r inferential statistics	
3	Recommen	ded prerequisites fo	or participation				
4	Form of exa Module exat • Modul The examina 16 students will be anno	amination m: e exam (Technical ex ation takes place in fo register, the examina ounced in the beginni	kamination, Oral/ orm of a written ex tion will be an ora ing of the lecture.	written examinatio am (duration: 90 n ll examination (dur	n, Duration: 90 Min. ninutes). If one can es ation: 45 min.). The	., Default RS) stimate that less than type of examination	
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation				
6	Grading Module exa • Modul	m: e exam (Technical ex	kamination, Oral/ [,]	written examinatio	n, Weighting: 100 %))	
7	Usability of M.Sc. etit -	the module SAE, M.Sc. WI-etit, M	1.Sc. CE, M.Sc. et	it - KTS, M.Sc. iCE,	B.Sc. und M.Sc. iST	, M.Sc. etit - VAS	
8	Grade bon u Yes	is compliant to §25	(2)				
9	References						

- Lecture notes and slides can be downloaded here:
 - http://www.spg.tu-darmstadt.demoodle
- Further reading:
 - Wes McKinney: Python for Data Analysis, O'Reilly, 2017
 - Christopher M. Bishop: Pattern Recognition and Machine Learning, 2011
 - James, Witten, Hastie and Tibshirani, Introduction to Statistical Learning, Springer, 2017

Courses

00						
	Course nr. 18-zo-2110-vl	Course name Data Science I				
	Instructor DrIng. Christiar	1 Debes	TypeLecture			
	Course nr. 18-zo-2110-ue	Course name Data Science I				
	Instructor DrIng. Christian	1 Debes	Type Practice	SWS 2		

Mo Res	dule name ilient Commu	nication Networks				
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	sm-2340	4 CP	120 h	75 h	1 Term	Summer term
Lar	iguage			Module owner		
Eng	English			Prof. Dr. rer. nat.	Björn Scheuermann	
1	 Teaching content The course covers the following topics: Resilience in the different disciplines Resilience in communication networks Importance of resilience for communication networks Requirements for current communication networks Methods to increase resilience in communications networks Wireless networks (e.g., mobile communications)					
2	 Learning objectives Students are familiar with the idea and necessity of resilience in various disciplines with a focus on adaptive communication networks. They are familiar with various methods for increasing resilience, such as redundancy and diversity, and can apply these methods to the design of communication networks. 					
3	Recomment	ded prerequisites fo	or participation			
4	Form of exa Module exar • Modul The examina 10 students will be anno	mination n: e exam (Technical ex ation takes place in f register, the examina unced in the beginni	kamination, Oral/ form of a written e tion will be an ora ing of the lecture.	written examinatio exam (duration: 90 al examination (du	n, Duration: 90 Min. min.). If one can estration: 30 min.) The	, Default RS) timate that less than type of examination
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	Grading Module exan • Modul	n: e exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of the module M.Sc. etit - DT, M.Sc. WI-etit, M.Sc. CE, M.Sc. etit - KTS, B.Sc. CE, M.Sc. iCE, B.Sc. und M.Sc. iST, M.Sc. etit - VAS					
8	Grade bonu Grade impro bonus exerci	s compliant to §25 ovements up to 0.4 a ises.	(2) ccording to APB 2	25(2) through bonu	is for regularly comp	leted and submitted
9	References					

A lecture notes or slides can be downloaded:

Moodle Platform

Advanced literature

- Smith, Paul, et al. "Network resilience: a systematic approach." IEEE Communications Magazine 49.7 (2011): 88-97
- Sterbenz, James PG, et al. "Resilience and survivability in communication networks: Strategies, principles, and survey of disciplines." Computer networks 54.8 (2010): 1245-1265
- Mauthe, Andreas, et. al. "Disaster-resilient communication networks: Principles and best practices." 2016 8th International Workshop on Resilient Networks Design and Modeling (RNDM). IEEE, 2016

Courses

0							
	Course nr.	Course name					
	18-sm-2340-vl	8-sm-2340-vl Resilient Communication Networks					
	Instructor		Туре	SWS			
	Prof. Dr. rer. nat.	Björn Scheuermann, DrIng. Tobias Meuser	Lecture	2			
	Course nr.	Course name					
	18-sm-2340-ue	Resilient Communication Networks					
	Instructor		Туре	SWS			
Prof. Dr. rer. nat. Björn Scheuermann, DrIng. Tobias Meuser Practice				1			

Mo Hai	dule name	ural Networks					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	zh-2010	6 CP	180 h	120 h	1 Term	Summer te	rm
Eng	i guage Ilish			Prof. DrIng. Li Z	Chang		
1	Teaching co	ntent					
	 Training and inference of neural networks Challenges in accelerating neural networks Computation cost reduction in neural networks Neural networks acceleration with logic design and FPGAs Neural networks acceleration with in-memory-computing platforms 						
2	Learning objectives Students that have completed this module know the development of neural networks and the challenges in accelerating neural networks with CPUs and GPUs. They can evaluate the computation cost of neural networks and select the corresponding methods to reduce the computation cost. They are also enabled to evaluate the performance of the different hardware acceleration platforms for neural networks.						
3	Recommend Basic program	ed prerequisites for nming skills in Pyth	or participation on.				
4	Form of exam Module exam • Module	mination 1: 2 exam (Technical ex	xamination, Exam	ination, Duration:	90 Min., Default RS)	I	
5	Prerequisite Passing the fi	for the award of canal module examination	redit points ation				
6	Grading Module exam • Module	ı: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)		
7	Usability of M.Sc. etit - D	the module ^o T, M.Sc. WI-etit, M.	.Sc. etit - AUT, M.	Sc. iCE, B.Sc. und	M.Sc. iST		
8	Grade bonus	s compliant to §25	(2)				
9	References Slides can be	downloaded throug	gh Moodle platfor	m.			
Cot	ırses						
	Course nr. 18-zh-2010-v	Course namevlHardware for 1	Neural Networks				
	Instructor Prof. DrIng.	Li Zhang			Type Lecture		SWS 2
	Course nr. 18-zh-2010-p	Course nameorHardware for	Neural Networks				
	Instructor Prof. DrIng.	Li Zhang			Туре Lab		SWS 2

Mo Nar	dule name					
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	me-2040	5 CP	150 h	105 h	1 Term	Summer term
Lan	Iguage			Module owner Prof Dr rer pat	Markus Meinert	
1	 Teaching content The lecture gives an overview of the technologies of nanoelectronics: Fabrication of devices on the nanometer scale Nanomaterials: quantum dots, nanowires, 2D materials (e.g. graphene) Quantum Metrology Triangle (single-electron transistor, quantum Hall effect, Josephson effect) FinFET transistors and other nanoscale devices 					
2	2 Learning objectives The students will know the basics of fabrication and application of electronic devices on the nanometer scale. They can describe the operating principles of modern nano-devices and understand the precise measurement of current, voltage, and resistance via quantum mechanical effects and physical constants. Within the seminar, the students give a presentation on a nanoelectronic method or device of their choice. Thereby, they gain the ability to conduct self-directed literature research and to give technical presentations.					
3	Recomment Basic knowle	ded prerequisites fo edge of semiconducto	or participation			
4	Form of exa Module exam • Modul The examina 10 students will be anno Seminar pre to 30 minute	mination n: e exam (Technical ex ation takes place in fo register, the examina unced in the beginni sentation about a sul es).	amination, Oral/ rm of a written ex tion will be an ora ng of the lecture. bject of Nanoelect	written examinatio am (duration: 90 n ll examination (dur ronics, individual (n, Duration: 90 Min. hinutes). If one can es ration: 30 min.). The 15 to 20 minutes) or	, Default RS) stimate that less than type of examination as teams of two (25
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exa • Modul	n: e exam (Technical ex	amination, Oral/	written examinatio	n, Weighting: 100 %)
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. WI-etit, M	1.Sc. iCE, B.Sc. ur	nd M.Sc. iST		
8	Grade bonu	s compliant to §25	(2)			
9	References					
	LecturFurthe	e slides will be made r literature will be an	available electron	nically the lecture		
Coi	ırses					

Course nr. 18-me-2040-vl	Course name Nanoelectronics		
Instructor Prof. Dr. rer. nat.	Markus Meinert	Type Lecture	SWS 2
Course nr. 18-me-2040-se	Course name Nanoelectronics		
Instructor Prof. Dr. rer. nat.	Markus Meinert	Type Seminar	SWS 1

2.2 Labs

Mo Lab	dule name oratory Contr	ol Engineering II						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
Lar	iguage	5.01	100 11	Module owner Prof. DrIng. Jür	gen Adamv	7	Winter term	.1
1	Teaching co During the l Non-linear co of an overhe	ontent aboratory course th ontrol of a gyroscope ad crane system, Pro	e following exper , Nonlinear multiv ogrammable logic	iments will be con variable control of a control of a stirring	ducted: Co an aircraft, g process	oupling co Servo con	ntrol of a hel trol systems,	licopter, Control
2	 2 Learning objectives After attending this module, a student is capable of: recalling the basics of the conducted experiments, organize and comprehend background information for experiments, assemble experimental set-ups based on manuals, judge the relevance of experimental results by comparing them with theoretically predicted outcomes, present the results of the experiments 							
3	Recommended prerequisites for participation System Dynamics and Control Systems II, the attendance of the additional lecture "System Dynamics and Control Systems III" is recommended							
4	Form of exa Module exar • Modul Report (inclu and/or Collo the beginnin	mination n: e exam (Study achie iding submission of p oquium (testate), but ig of the lecture.	vement, Oral/wrig programming code never more than	tten examination, I) and/or Presentati two out of it. The t	Default RS) ion and/or type of exam	Oral exam mination v	ination (25 n will be annou	ninutes) nced in
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - EET, M.S	Sc. WI-etit, M.Sc.	CE, M.Sc. etit - AU	T, B.Sc. un	d M.Sc. iS	T, M.Sc. etit	- VAS
8	Grade bonu	s compliant to §25	(2)					
9	References Adamy: Inst	ruction manuals for	the experiments (available during the	e kick-off m	neeting)		
Co	ırses							
	Course nr. 18-ad-2060-	pr Laboratory Co	ntrol Engineering	II				
	Instructor M.Sc. Nikola	as Hohmann, Prof. D	rIng. Jürgen Ada	ımy		Type Lab		SWS 4

Mo Pov	dule name ver Laborator	y I				
Mo 18-	dule nr. bt-2091	Credit points 5 CP	Workload 150 h	Self-study 105 h	Module duration	Module cycle Winter term
Lar Gei	nguage rman/English			Module owner Prof. DrIng. Yve	s Burkhardt	
1	 Teaching content Safety instructions for laboratory; Topic of experiments: Electrical energy conversion Power electronics High voltage technology Electrical energy supply Renewable energies 					
2	Learning ol After compl electrical po	bjectives etion of the module, wer engineering.	the students have	e learned to work	practically in small g	roups on tasks from
3	Recommen Power Engir	ded prerequisites fo neering or similar	r participation			
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture 					
5	Prerequisite Passing the	e for the award of c final module examina	r edit points ation			
6	Grading Module exa • Modul	m: le exam (Study achie	vement, Oral/writ	tten examination, V	Veighting: 100 %)	
7	Usability of M.Sc. ESE, I	the module M.Sc. etit - EET, M.Sc	e. WI-etit, M.Sc. C	E, B.Sc. und M.Sc.	iST	
8	Grade bonu	is compliant to §25	(2)			
9	 References A. Binder et al.: Textbook with detailed description of experiments; A. Binder et al.: Skript zur Lehrveranstaltung mit Versuchsanleitungen; J. Hindmarsh: Electrical Machines and their Application, Pergamon Press, 1991 S. A. Nasar, C. Trutt: Electric Power systems, Taylor & Francis, 1998 N. Mohan et al.: Power Electronics, Converters, Applications and Design, Wiley, 2002 D. Kind, H. Kärner: High-Voltage Insulation Technology, Vieweg & Teubner, 1985 					
Co	urses					

	Course nr.Course name18-bt-2091-prPower Laboratory I			
	Instructor		Type	SWS
	Prof. DrIng. Yves Burkhardt		Lab	3
	Course nr. 18-bt-2090-tt	Course name Laboratory Briefing		
Instructor		usinger, Prof. DrIng. Yves Burkhardt	Type	SWS
DrIng. Björn Deusinger, Prof. DrIng. Yve			Tutorial	0

Mo	dule name	7 TI					
Mo	dule nr.	Credit points	Workload	Self-study	Module dura	tion Module c	vcle
18-	bt-2092	5 CP	150 h	105 h	1 Term	Summer t	erm
Lar Ger	iguage man/English			Module owner Prof. DrIng. Yve	s Burkhardt		
1	Teaching co Practical cou power distri concerning "	ntent irse on power engind bution and high vol field-oriented contro	eering - Distributi tage engineering; ıl" of variable spee	on and Applicatior About 50% are d d drives, encoder s	n. About 50% o ealing with ap ytems	of the units are de plication in drive	voted to systems,
2	Learning of After comple electrical po	jectives etion of the module, wer engineering in a	, the students hav practical and ind	ve learned to work ependent manner.	in small grou	ps on in-depth ta	sks from
3	Recomment Power Engin	led prerequisites for eering or similar	or participation				
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the baging of the logture 					minutes) unced in	
5	Prerequisite Passing the f	e for the award of c inal module examina	redit points ation				
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100	%)	
7	Usability of M.Sc. ESE, M	the module A.Sc. etit - EET, M.So	c. WI-etit, M.Sc. C	E, B.Sc. und M.Sc.	iST		
8	Grade bonu	s compliant to §25	(2)				
9	References Text book w	ith detailed laborato	ry instructions				
Coi	ırses						
	Course nr. 18-bt-2092-j	or Power Laborat	ory II				
	Instructor Prof. DrIng	Yves Burkhardt			Tyı Lab	pe D	SWS 3
	Course nr. 18-bt-2090-t	t Laboratory Bri	efing				
	Instructor DrIng. Björ	n Deusinger, Prof. Di	rIng. Yves Burkh	ardt	Tyr Tut	pe torial	SWS 0

Mo Pra	dule name ctical Training	g with Drives						
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
Lan	iguage	5 CP	130 11	Module owner			Every Serile	
Ger	man/English			Prof. DrIng. Yve	s Burkhard	t		
1	Teaching co The purpose An introduct drives to wo fed AC drive respective co	ontent of this laboratory is ion in measurement rk and investigating of s. The laboratory ex- ourses (ETiT or MEC)	gaining extented problems concerr drive systems und xperiments are in).	knowledge about ro ning drives is given er laboratory condi dividually coordina	ealization a The conte tions. Speci ated with t	and behavi ents of the ial attention he previor	iour of drive s laboratory is on is paid to i us knowledge	systems. setting nverter- e of the
2	Learning of The student	jectives s get the ability of m	easurement for ele	ectrical motors, ger	nerators and	d transfor	mers.	
3	Recomment Bachelor of	led prerequisites fo Science in Electrical	or participation Engineering, Powe	er Engineering or s	imilar			
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - EET, M.S	Sc. WI-etit, M.Sc.	CE, B.Sc. und M.Sc	. iST			
8	Grade bonu	s compliant to §25	(2)					
9	 9 References Textbook with lab instructions W. Nürnberg: Die Prüfung elektrischer Maschinen, Springer, 2000 P. Brosch: Moderne Stromrichterantriebe, Kamprath-Reihe, Vogel-Verlag, 1998 Textbook - A. Binder: Motor Development for Electrical Drive Systems Textbook - G. Griepentrog: Control of Drives 							
Coι	irses	Courses						
	Course nr.Course name18-bt-2100-prPractical Training with Drives							
	InstructorTypeSWSProf. DrIng. Yves Burkhardt3							

Course nr. 18-bt-2090-tt	Course name Laboratory Briefing		
Instructor DrIng. Björn De	usinger, Prof. DrIng. Yves Burkhardt	Type Tutorial	SWS 0

Mo Ser	dule name ious Games La	ıb						
Мо	dule nr.	Credit points	Workload	Self-study	Module duratio	n Module cy	cle	
18-	de-2060	6 CP	180 h	120 h	1 Term	Every Seme	ester	
Lar Ger	iguage man/English			Module owner PD DrIng. Stefa	n Göbel			
1	Teaching co In this lab th education, he	ntent le students will desi ealth and sports).	gn concepts and :	implement prototy	pes in the field o	serious games	(e.g. in	
	The topics relate to current research questions in the field, partly in cooperation with partners from the games industry and/or Serious Games users.							
2	2 Learning objectives After successfully attending the course, the students can conceptualize and prototypically implement practical tasks in the context of "Serious Games". Besides, the students are able to present their findings in front of an audience applying a number of different presentation techniques and to actively participate in a scientific discussion on their topic.							
3	B Recommended prerequisites for participation Programming skills (depending on topic).							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture 							
5	Prerequisite Pass exam (1	for the award of c 00%)	redit points					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)		
7	Usability of M.Sc. etit - D	the module OT, M.Sc. CE, B.Sc. (CE, B.Sc. und M.S	c. iST				
8	Grade bonus	s compliant to §25	(2)					
9	References							
Co	ırses							
	Course nr.	Course name	alah					
	Instructor PD DrIng. S	tefan Göbel	, LUV		Type Lab		SWS 4	

Mo Net	Module name Network and Cyber-physical Systems Lab							
Mo 18-	dule nr. fi-2050	Credit points 5 CP	Workload 150 h	Self-study 105 h	Module duration 1 Term	Module cy Winter term	cle n	
Lar Gei	nguage rman/English			Module owner Prof. DrIng. Rol	f Findeisen	·		
1	Teaching co Based on di for network tion systems communicat	ontent fferent laboratory te interconnected cybe s. The main goal is ion effects.	est benches and si er-physical systems to apply design a	mulation studies tl s, spanning from m pproaches and an	he students will app obile-robots, drones alyze the impact of	bly controller s, to complex a interconnecti	designs automa- ion and	
2	Learning ol After this la controlled v design and a	ojectives b the students will u ia a communication p apply different contro	Inderstand the change network. They wil oller design appro	allenges of control l be able to analyse aches and make th	ling interconnected e network and cyber em work on a labor	systems and s -physical syste atory experime	systems ems and ent.	
3	Recommen Fundamenta	ded prerequisites fo al knowledge of basic	or participation control and the a	nalysis and control	of interconnected c	yber-physical s	systems.	
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	m: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)			
7	Usability of M.Sc. WI-et	t he module it, M.Sc. CE, M.Sc. e	tit - VAS					
8	Grade bonu	is compliant to §25	(2)					
9	References Lecture note	es for the lab tutorial						
Co	urses							
	Course nr.Course name18-fi-2050-prNetwork and Cyber-physical Systems Lab							
	I8-fi-2050-prNetwork and Cyber-physical Systems LabInstructorTypeSWSProf. DrIng. Rolf FindeisenLab3							

Mo Lab	dule name ooratory Matla	ıb/Simulink II						
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cy	cle
18-	fi-2100	6 CP	180 h	120 h	1 Term		Every Seme	ester
Lar	nguage			Module owner				
Ger	rman			Prof. DrIng. Rol	f Findeisen	1		
1	Teaching co The lab is sp tool Simulin the second p problems as	ntent lit into the two parts k are introduced and part, the knowledge well as simulation t	s Simulink and Cor l their application gained in the first asks.	ntrol Engineering II to problems from c part is applied to a	. First the f lifferent fie utonomous	fundamen elds of app sly solve so	tals of the sim lication is trai everal control	ulation ined. In design
2	 Learning objectives The students will be able to work with the tool MatLab/Simulink on their own and can solve tasks from the areas of control engineering and numericial simulation. The students will know the different design methods of the control system toolbox and the fundamental concepts of the simulation tool Simulink. They can practically apply the knowledge gathered in the lectures "System Dynamics and Control Systems I and II" and "Modelling and Simulation". 							
3	3 Recommended prerequisites for participation The lab should be attended in parallel or after the lectures "System Dynamics and Control Systems II" and "Modelling and Simulation"							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the beginning of the lecture 							
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	. CE, M.Sc. etit - A	UT, M.Sc. MedTec	B.Sc. und	M.Sc. iST	•	
8	Grade bonu	s compliant to §25	(2)					
9	9 References Lecture notes for the lab tutorial can be obtained at the secretariat							
Co	urses							
	Course nr.Course name18-fi-2100-prLaboratory Matlab/Simulink II							
	Instructor Prof. DrIng	. Rolf Findeisen. M.S	c. Joachim Schaef	fer, M.Sc. Philipp H	olzmann	Type Lab		SWS 4

Mo Adv	Module name Advanced Integrated Circuit Design Lab								
Mo 18-	dule nr. ho-2120	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module durati 1 Term	on Module cy Summer te	cle rm		
Lar Eng	1guage glish		1	Module owner Prof. DrIng. Kla	us Hofmann				
1	Teaching co Practical Des Tools	ontent sign Tasks in Full Cu	stom Design of Dig	ital or Analog Cirui	ts using State-of-	the-Art Commerc	cial CAD		
2	 2 Learning objectives A student is, after successful completion of this module, able to 1. develop and verify transistor circuitry using Cadence 2. simulate logic and analog circuits (Pre- and Postlayout) 3. draw, verify and extract layout After successful completion of this module the students are able to work constructively on a feasible solution. Aside, they are able to mutually support each other and present intermediate results to peers, and achieve an overall feasible solution. 3 Recommended prerequisites for participation 								
3	Recommend Lecture "Adv	led prerequisites f earer vanced Digital Integr	or participation rated Circuit Desig	n" or "Electronic a	nd Integrated Cir	cuits"			
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate). The type of examination will be announced in the beginning of the lecture. 								
5	Prerequisite Passing the f	e for the award of o	e redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Neighting: 100 %))			
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.S	c. etit - SAE, M.Sc	. WI-etit, M.Sc. CE	, M.Sc. iCE, B.Sc	und M.Sc. iST			
8	Grade bonu	s compliant to §25	(2)						
9	 9 References ADIC Lecture Slide Copies John P. Uyemura: Fundamentals of MOS Digital Integrated Circuits Neil Weste et al.: Principles of CMOS VLSI Design 								
Co	urses	Courses							
	18-ho-2120-	pr Advanced Inte	e egrated Circuit Des	sign Lab					
	Instructor Prof. DrIng	. Klaus Hofmann			Type Lab		SWS 3		

Mo	dule name								
Sim	ulation of Ele	Credit points	rks Morkland	Solf study	Modulo	duration	Modulo av	alo	
18-	hs-2100	3 CP	90 h	60 h	1 Term	uuration	Winter tern	n	
Lar Ger	iguage man			Module owner Prof. DrIng. Jutt	ta Hanson		1		
1	Teaching co Modeling, si consideration energy resou	ontent imulating and plann n of electrical equipm urces und reactive po	ing electrical pov ent (overhead line ower compensation	ver networks with s, cables, transform n systems)	a wide rai ers, conve	nge of non ntional pov	ninal voltages ver plants, rer	s under 1ewable	
2	 2 Learning objectives Upon completion of the module, students were taught: Modeling various electrical power systems using the appropriate techniques. Choice of static and dynamic simulation techniques after analysing the concrete simulation processes. Understanding the behaviour of various equipment in the electric power system, especially renewable energy resources. Interpretion of results based on the fundamental questions of modeling and simulating electrical power systems. 								
3	Recommender Basics of elements	ded prerequisites for ctrical power systems	or participation						
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report (including submission of programming code) and/or Presentation and/or Oral examination (25 minutes) and/or Colloquium (testate), but never more than two out of it. The type of examination will be announced in the baginping of the logture 								
5	Prerequisite Passing the f	e for the award of c	redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of M.Sc. ESE, N	the module M.Sc. etit - EET, M.So	c. WI-etit, M.Sc. C	E					
8	Grade bonu	s compliant to §25	(2)						
9	References Script, Prese	entation Slides, Desci	ription of tutorial	and basic network	data				
Coι	urses								
	Course nr. 18-hs-2100-	pr Simulation of	Electrical Power N	letworks					
	18-hs-2100-pr Simulation of Electrical Power Networks Instructor Type SWS M.Sc. Anna Pfendler, M.Sc. Felix Korff, Prof. DrIng. Jutta Hanson, M.Sc. Lab 2								

Mo Lig	dule name hting Technol	ogy I						
Mo	dule nr. kh-2010	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module 1 Term	duration	Module cyc Winter tern	c le n
Lar Ger	iguage man			Module owner Prof. DrIng. Tra	n Quoc Kh	anh		
1	Teaching co Structure ar and photom Measurement responsivity optical mate	ontent ad functionality of th etric properties of m nt of luminous flux, function of the hun rial characteristics, I	e human eye, terr aterials, filters, ph luminous intensi nan eye, colorime .ED properties	ns and unit in ligh ysiology of vision, ity, illuminance, lu try colour renderir	ting techn colour the iminance, ig, colour	ology, phot ory, lightin determina as traffic si	cometry, radio g, light sourc ation of the s gnals, measu	ometric es. spectral uring of
2	Learning of On completi • To list techno • to dese • to illus They are abl with experin	on of the module stu and connect terms ology cribe and understance strate basics of lighting e to measure base it nents and have deve	idents will have le , units and radior l structure and fur ng, measuring me ems in lighting teo loped a better und	arned the following netric and photon nctionality of the h thods and applicati chnology, applying lerstanding for ligh	g: netric prop uman eye on. knowlegdo t and colo	perties of r and the ph e of lighting r.	naterials in 1 lysiology of vi g and enhanc	lighting ision ce them
3	Recomment MSc ETiT, N	ded prerequisites fo ISc Wi-ETiT, MSc MI	or participation EC					
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 							
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exa • Modul	n: e exam (Technical e:	xamination, Oral e	examination, Weigh	nting: 100	%)		
7	Usability of B.Sc. etit, M WI-etit	the module I.Sc. MEC, M.Sc. et	it - SAE, M.Sc. W	I-etit, M.Sc. CE, M	I.Sc. Med	ec, B.Sc. ۱	und M.Sc. iS	T, B.Sc.
8	Grade bonu	s compliant to §25	(2)					
9	9 References Script for lecture: Lighting Technology I Excersisebook: laboratory: lighting technology I							
Co	urses							
	Course nr. 18-kh-2010-	vl Course name Lighting Tech	nology I					1
	Instructor Prof. DrIng	. Tran Quoc Khanh,	DrIng. Babak Zai	ndi, M.Sc. Felix Wi	rth	Type Lecture		SWS 2

Course nr. 18-kh-2010-pr	Course name Lighting Technology I		
Instructor Prof. DrIng. Tran Quoc Khanh, DrIng. Babak Zandi, M.Sc. Felix Wirth		Type Lab	SWS 2

Mo	dule name						
Adv	anced Lighting	Technology		1		1	
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle rm
Lan		0.01	100 11	Module owner	1 101111	builliner te	
Ger	man			Prof. DrIng. Tra	n Quoc Khanh		
1	Teaching com Chosen topics Detektion / G of Light Meas Automotive Li	a tent s in lighting techno lare / Lighing and surement, Interiou ghting, Solar Modu	ology - current de Health, LED - Ge r Lighting, Displa ıles.	evelopments and a neration of white I y Technologies, N	applications: Street ight / State of the A on-visual Light Impa	lighting, Phy rt, Modern N acts,UV-Appli	siology: Iethods cations,
2	 Learning objectives On completion of the module students will have learned the following: They know current developments and applications, list and connect terms, to illustrate special topics of lighting, measuring methods and application. They are able to measure base items in lighting technology, applying knowlegde of lighting and dedicated applications and further to enhance them with experiments. They have developing a better understanding for light, color, perception and lighting situations. 						
3	Recommended prerequisites for participation Lighting Technology I						
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the fi	for the award of c nal module examina	redit points ation				
6	Grading Module exam • Module	: exam (Technical e:	xamination, Oral 6	examination, Weigl	nting: 100 %)		
7	Usability of t M.Sc. MEC, M	he module I.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, M.Sc. MedTec,	B.Sc. und M.Sc. iST		
8	Grade bonus	compliant to §25	(2)				
9	References Excercisebool	: laboratory: lighti	ng technology II				
Coι	ırses						
	Course nr. 18-kh-2020-v	Course nameAdvanced Light	nting Technology				
	Instructor Prof. DrIng.	Tran Quoc Khanh			Type Lecture		SWS 2
	Course nr. 18-kh-2020-p	r Advanced Ligh	nting Technology				
	Instructor Prof. DrIng.	structor Type SWS of. DrIng. Tran Quoc Khanh 2					

Mo	dule name						
Sol	id State Light	ing		1			
Mo 18-	dule nr. kh-2060	Credit points 5 CP	Workload 150 h	Self-study 90 h	Module duration	n Module cy Winter terr	cle n
Lar Ger	nguage man			Module owner Prof. DrIng. Tra	n Quoc Khanh		
1	Teaching co Basics of ligh optics, phos of LEDs; LE engineering sources; cho according to colour recog training: the	ontent at and colour percept phors; phosphor mi D models; lifetime a ; optical sensors; ser pice and combinatio o their technological gnition, spectral reco ermic, electric and lig	ion; basics of solid xtures; colour an nd defect mechar niconductor based n of LEDs in prac parameters; ligh onstruction; intelli ghting engineering	state light sources d white LEDs; tem nisms of LEDs; OLF l cameras; colour s ctical LED luminai ting quality metric gent automotive a g related measurem	LEDs: material s perature, curren Ds and semicono ensors; colour qu res; flicker; grou s; intelligent ind nd outdoor lighti ent of LED light s	ystems, structura and optical be luctor lasers in l ality of solid sta ping (binning) o por lighting wit ng with LEDs; p ources.	ll shape, haviour lighting ite light of LEDs h LEDs: iractical
2	Learning of Principles ar and the opti	ojectives ad applications of the misation of visual pe	technology of soli erception under LE	d state light source D light in modern	s in lighting engin lighting engineer	neering; LED tec ng.	hnology
3	Recomment Lichttechnik	ded prerequisites fo	or participation				
4	 Form of examination Module exam: Module exam (Technical examination, Oral examination, Duration: 30 Min., Default RS) 						
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation				
6	Grading Module exa • Modul	n: e exam (Technical e:	xamination, Oral e	examination, Weigh	tting: 100 %)		
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. WI-etit, M	Л.Sc. CE				
8	Grade bonu	s compliant to §25	(2)				
9	 9 References • LED-Lighting: Technology and Perception (Khanh, Bodrogi, Vinh, Winkler; Editors, Wiley-VCH, 2015) • Introduction to Solid State Lighting (Zukauskas et al., Wiley, 2002) • Light Emitting Diodes (Schubert; Cambridge Univ. Press, 2003) 						
Coι	ırses						
	Course nr.Course name18-kh-2060-vlSolid State Lighting						
	Instructor Prof. DrIng	. Tran Quoc Khanh,	DrIng. Alexande	r Herzog	Type Lectu	re	SWS 2

Course nr. 18-kh-2060-pr	Course name Praktikum Halbleiterlichttechnik		
Instructor Prof. DrIng. Tra	n Quoc Khanh, DrIng. Alexander Herzog	Type Lab	SWS 2

Mo	dule name	munications I ab II				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar	nguage	0 CP	100 11	Module owner	f Steinmetz	Every Semester
Image: Content and Participation Prof. Dring. Kan Steinmetz I Teaching content The course deals with cutting-edge development topics in the area of multimedia communication system Besides a general overview, it provides a deep insight into a special development topic. The topics are selected according to the specific working areas of the participating researchers and convey technical and basic scientific competencies in one or more of the following topics: Network planning and traffic analysis Performance evaluation of network applications Discrete event simulation for network services Protocols for mobile ad hoc networks / sensor networks Infrastructure networks for mobile communication / mesh networks Context-aware communication and services Peer-to-peer systems and architectures Content distribution and management systems for multimedia/e-learning Multimedia authoring and re-authoring tools Web service technologies and service-oriented architectures Adaptive educational technologies Natural language processing in education 						munication systems. le topics are selected al and basic scientific
2	 Natural language processing in education The concrete list of topics can be found each semester on the corresponding teaching website of KOM. Learning objectives The ability to solve and evaluate problems in the area of design and development of future multimedia communication networks and applications shall be acquired. Acquired competences are: Design of complex communication applications and protocols Implementing and testing of software components for distributed systems Application of object-oriented analysis and design techniques Acquisition of project management techniques for small development teams Writing of software documentation and project reports Presentation of project advances and outcomes 					
3	Recomment Keen interes expect: • Solid e • Solid e • Solid e • Lectur	ded prerequisites for st to explore challen experience in program knowledge in object of knowledge in compute es in Communication	or participation ging topics which mming Java and/o priented analysis a ter communication n Networks I (II, II	a are cutting edge or C# (C/C++) and design n networks are reco II, or IV) are an ado	in technology and ro ommended ditional plus	esearch. Further we
4	Form of exa Module exa • Modul Report (inclu and/or Collo the beginnir	mination m: e exam (Study achie uding submission of p oquium (testate), but ng of the lecture.	vement, Oral/writ programming code never more than	tten examination, I) and/or Presentati two out of it. The t	Default RS) on and/or Oral exam type of examination v	iination (25 minutes) will be announced in
5	Prerequisite Passing the	e for the award of c	reait points			

6	Grading						
	Module exam:						
	Module exa	 Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 					
7	Usability of the	module					
	M.Sc. etit - DT, N	I.Sc. WI-etit, M.Sc. CE, M.Sc. iCE, B.Sc. und M.Sc. iST					
8	Grade bonus co	mpliant to §25 (2)					
		• • • • • •					
9	References						
	Each topic is cov	rered by a selection of papers and articles. In addition we re	ecommend reading of s	elected			
	chapters from fol	lowing books:	-				
	Andrew Tag	nenbaum: "Computer Networks". Prentice Hall PTR (ISBN 013	30384887)				
	Christian U	llenboom: "Java ist auch eine Insel: Programmieren mit der Ja	va Standard Edition Ver	sion 5 /			
	6" (ISBN-13	3: 978-3898428385)					
	 Joshua Blo 	ch: "Effective Java Programming Language Guide" (ISBN-13: 9	978-0201310054)				
	Erich Gam	na, Richard Helm, Ralph E. Johnson: "Design Patterns: Objec	cts of Reusable Object O	riented			
	Software" (ISBN 0-201-63361-2)	5				
	Kent Beck:	"Extreme Programming Explained - Embrace Changes" (ISBN-	-13: 978-0321278654)				
Cot	urses						
	Course nr.	Course name					
	18-sm-2070-pr	Multimedia Communications Lab II					
	Instructor		Tuno	CINC			
	Drof Dr. nor	Diam Cohousemann Du Ing, Julian Zohal M.C. Fuid-lin	Type	2000			
	PIOL Dr. rer. nat	. Bjorn Scheuermann, Dr. Ing. Julian Zodel, M.Sc. Fridolin	LaD	5			
	Siegmund, Prof.	DrIng. Kalf Steinmetz					

Mo Intr	dule name	Scientific Computing	with Python			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	st-2070	4 CP	120 h	90 h	1 Term	Summer term
Lan Ger	i guage man			Prof Dr rer pat	Florian Steinke	
1	 Teaching content Scientific computing is introduced via six case studies. Exemplary engineering problems that are know from basic engineering courses are solved on a computer using fundamental methods from numerical mathematics. Opportunities and limitations of this approach are highlighted. The required material on numerical mathematics is taught via preparatory scripts for each case study. During the practical exercises the methods are implemented in the current computing environment Python 					
	 During the practical exercises the methods are implemented in the current computing environment Python under the guidance of suitable teaching personnel. The case studies cover the following numerical topics: Formulation and solution of systems of linear equations, sparse methods Integration of ordinary differential equations (ODE) and their analysis based on eigenvalues Mathematical optimization and automated differentiation Linear regression and approximation, first Machine Learning algorithms Discretization of simple partial differential equations (PDE) 					
2	 Learning objectives After completing the module, the students have learned to work on engineering problems with modern computer tools and to use important basic technologies of scientific computing in a targeted manner. In doing so, the students have been taught an algorithmic way of thinking and are able to assess the possibilities and limitations of computer-based computational methods. 					
3	Recommen Etit 1 & 2, M	ded prerequisites fo Mathe for etit 1-3	or participation			
4	Form of exa Module exa • Modul The exact for experimenta	amination m: le exam (Study achie orm of the examinati al descriptions and/o	vement, Oral/writ on will be annou r a presentation o	tten examination, I nced at the beginn f experimental rest	Default RS) ing of the first cours ılts will be prepared.	e. Either a report of
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exa • Modu	m: le exam (Study achie	vement, Oral/writ	tten examination, V	Veighting: 100 %)	
7	Usability of B.Sc. etit, N	f the module I.Sc. MEC, M.Sc. ESE	E, M.Sc. CE, M.Sc.	etit - KTS, M.Sc. M	ledTec, B.Sc. und M.	.Sc. iST
8	Grade bonu	is compliant to §25	(2)			
9	References					
Coι	ırses					

Course nr. 18-st-2070-pr	Course name Introduction to Scientific Computing with Python		
Instructor Prof. Dr. rer. nat. rer. nat. Sebasti Markus Meinert	. Florian Steinke, Prof. DrIng. Herbert De Gersem, Prof. Dr. an Schöps, Prof. Dr. techn. Heinz Köppl, Prof. Dr. rer. nat.	Type Lab	SWS 2

Mo Dig	dule name	cessing Lab					
19	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle
Lar Eng	iguage glish	0 Gr	100 11	Module owner Prof. DrIng. Abdelhak Zoubir			
1	1 Teaching content 1. Introduction to MATLAB 2. Discrete-Time Signals and Systems 3. Frequency-Domain Analysis using the DFT 4. Digital FIR Filter Design 5. IIR Filter Design using Analog Prototypes 6. Nonparametric Spectrum Estimation 7. Parametric Spectrum Estimation.						
2	Learning objectives The students are able to apply skills acquired in the course Digital Signal Processing. These include the design of digital FIR and IIR filters as well as non-parametric and parametric spectrum estimation. Students learn how MATLAB is used to apply theoretical concepts and to demonstrate signal processing techniques by using hands-on application examples.						
3	Recommended prerequisites for participation Fundamentals of Signal Processing						
4	 Form of examination Module exam: Module exam (Study achievement, Written examination, Duration: 120 Min., Default RS) Exam (Duration: 120 min) and a Beport (Lab Beports). Details will be appounded at the beginning of the lecture. 						
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exan • Module	n: e exam (Study achie	vement, Written e	examination, Weigh	nting: 100 %)		
7	Usability of M.Sc. WI-eti	the module t, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. M	edTec, M.Sc. iCE, I	3.Sc. und M.Sc. iST,	M.Sc. etit - V	AS
8	Grade bonu	s compliant to §25	(2)				
9 Coi	References Lab manual urses						
	Course nr. 18-zo-2030-j	or Digital Signal	Processing Lab				
	Instructor Prof. DrIng.	Abdelhak Zoubir	-		Type Lab		SWS 3

Mo Thi	dule name n films and sp	intronics lab					
Mo	dule nr.	Credit points	Workload	Self-study	Module durat	ion Module cy	cle
18-1	me-2050	5 CP	150 h	105 h	1 Term	Every Seme	ester
Lan Eng	i guage lish			Module owner Prof Dr rer nat	Markus Meiner	r	
1	 Teaching content In several blocks, students have the opportunity to produce magnetic thin films and devices in the lab and cleanroom and to measure their properties: Production of metallic thin films using magnetron sputtering, giant magnetoresistance (GMR), and interlayer coupling (RKKY) Production of an AMR-based "barber pole" magnetic field sensor using lift-off lithography Measurement of magnetic hysteresis in thin films, characterization of magnetization and magnetic damping with GHz broadband spectroscopy, characteristics of magnetic tunnel junctions 						
2	Learning objectives Through the module, students learn how to handle equipment for the production of thin metallic layer systems. They carry out lithographic preparation in the cleanroom under the guidance of the instructor. Upon completion of the module, students will have a basic understanding of thin film technology, the associated process technology, and highly sensitive magnetic field sensors.						
3	Recommended prerequisites for participation Introduction to spintronics						
4	Form of exa Module exam • Module Report (inclu and/or Collo the beginnin	mination n: e exam (Study achie ding submission of p quium (testate), bu g of the lecture.	evement, Oral/wri programming code t never more than	tten examination, I) and/or Presentati two out of it. The t	Duration: 25 Mi ion and/or Oral type of examina	n., Default RS) examination (25 r tion will be annou	ninutes) ınced in
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exan • Module	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Neighting: 100	%)	
7	Usability of M.Sc. iCE, B	the module .Sc. und M.Sc. iST					
8	Grade bonu	s compliant to §25	(2)				
9	References Script and sl	ides for the internsh	ip Thin films and	spintronics lab			
	11 3C3	Courses					
	18-me-2050-	pr Thin films and	l spintronics lab				
	Instructor Prof. Dr. rer.	nat. Markus Meiner	rt		Тур Lab	2	SWS 3

2.3 Seminars

Mo Des	dule name sign of Electric	cal Machines and Act	uators with Nume	erical Field Calcula	tion			
Мо	dule nr.	Credit points	Workload	Self-study	Module d	uration	Module cyc	cle
18-	bt-2110	5 CP	150 h	120 h	1 Term		Summer ter	rm
Lar	iguage			Module owner	Iodule owner			
1	Teaching co Introduction FEM, 2D ele applications Calculation	ontent to Finite Element M ectromagnetic Desig such as squirrel-cag of temperature distri	lethod (FEM), Bas n of transformers e machines (Exam bution within pow	ic examples of elec , AC machines, pe ple: Wind generat er devices	ctromagneti ermanent n or); Cooling	ic devices nagnet de g systems	designed in 2 vices; eddy and thermal	2D with current design:
2	2 Learning objectives Upon completion of the module, students will have a good knowledge in applying Finite Element software packages to basic field problems.							
3	Recommended prerequisites for participation Strongly recommended is the attendance of lecture and active co-operation in the tutorial "Energy Converters - CAD and System Dynamics"							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation and/or Colloquium. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/writ	ten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - EET, M.S	Sc. WI-etit, M.Sc.	CE, B.Sc. und M.So	e. iST, M.Sc	. etit - CM	ΊΕΕ	
8	Grade bonu	s compliant to §25	(2)					
9	References Detailed tex	tbook; Müller, C. Gro	oth: FEM für Prak	tiker - Band 1: Gru	ndlagen, ex	xpert-Verla	ıg, 5. Aufl., 2	000
Coi	ırses							
	Course nr. 18-bt-2110-s	Course name Se Design of Elec	trical Machines an	d Actuators with N	Numerical F	ield Calcu	lation	
	Instructor DrIng. Bog	dan Funieru				Type Seminar		SWS 2

Mo	dule name	lightion of Electrical	Drives (Drives fo	r Electric Vehicles)				
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
18-	bt-2120	5 CP	150 h	120 h	1 Term		Summer ter	rm
Lar Ger	iguage man			Module owner Prof. DrIng. Yves Burkhardt				
1	 Teaching content Content of the lecture part: Mono- and hybrid drive concepts, motor technology, DC and AC machines, drive systems, car dynamic, energy storage; Content of the seminary work: simulation of car with electric drive train, presentation of seminary work 							
2	Learning objectives After completing the module, students have acquired knowledge of the basic design procedures for electric drives in hybrid and electric cars.							
3	Recommend Bachelor in I	led prerequisites fo Electrical Engineerin	or participation g or Mechatronics	s, "Electrical Drives	and Machi	nes" and "	Power electro	onics"
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation and/or Colloquium. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	e for the award of c inal module examina	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	it - EET, M.Sc. WI	-etit, M.Sc. CE, B.S	c. und M.S	c. iST		
8	Grade bonu	s compliant to §25	(2)					
9	References • Textbook • Binder, A.: Electric machines and drives • Mitschke, M.: Dynamik der Kraftfahrzeuge, Springer Verlag Berlin							
Coi	ırses							
	Course nr. 18-bt-2120-s	e Planning and	application of elec	trical drives (Drive	s for electri	ic vehicles)	
	Instructor		**	<u> </u>		Type Seminar		SWS 2

Module name KeySskills With a	Focus on Language				
Module nr. 18-de-2118	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration 1 Term	Module cycle Winter term
Language German			Module owner Katharina Dehn		
 Teaching constrained in the seminary in the seminary programme that they can the aim of a vocabulary of the cultural be able to constrained the seminary requested of Main topics: Punctrient Phone lexis/rient Seman Text ty Different Speecient Block series in the support finding expliditferent idea and solution Living Workint Effection Expection Phone The support finding effection Expection Phone The intercuration of the support of the su	ontent "Speaking and writt har, students are train in the area of oral ar n be used in the subj the seminar is, on the problems in the narro omply with these, but is structured in a lear produced. Attaion (e.g. the hyph tics norphology (e.g. com tics/grammar (e.g. p /pes and style levels ence between oral an n, CV, application, e ninar "Key Qualification seminar "Key Qualification e one hand help the rt in making their station anations as to why G tas can lead to misum a strategies are develo- and studying in Ger- ng successfully in a to ve learning and time tations in the universi- tics (1-day workshops at a current topics int in the workshops at a potenties.	ing scientifically' ned in competence of written commu- ect studies. e one hand, to exp rower sense) and, pression typology wer sense (i.e. scient and typology and typology and typology bassive and passive ad written expresses mails ations": ications", students m to find their wa and here successful ermans are the war derstandings. By oped. Seminar blo many (1-day works ermanagement (1- sity context (1-day works) and the workshops. any time. Subject-	 ': es that are expecte nication. Own text pand the students' on the other han (text type convent entific habitus, spear-generalising inappas far as this is int lds) e-verb tense) ion a receive interculturation are everyday life . The students are hy they are, which working together, pocks are sshop) hop) day workshop) the coordinators o If necessary, it is prelated, organisation 	d of students in the I s are worked out in s general linguistic co d, to make them tra ions, etc.) by making aker role, language st propriate functionally erculturally feasible.	Mechatronics degree cientific language so mpetence (above all nsparent and aware g them aware of the tyle, etc.) in order to v imitative behaviour. Authentic material is ng in five workshops, the other hand give ring themselves and in Germany and why gether are addressed

	 After succesfully attending this module the students will be capable of structuring their written and oral communication, using techniques for lecturing and presenting, designing handouts, framing statements and reports scientifically, understanding and analyzing Germany's cultural standards and habits, coping with misunderstandings appearing in private and university contexts using strategies of deescalation, developing understanding for expectations within the university context and act accordingly, defining strategies for successful teamwork and act accordingly, employing methods of effective learning, carrying out effective time management, identifying their own potential and to cope with special challenges.
3	Recommended prerequisites for participation
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 30 Min., Default RS)
5	Prerequisite for the award of credit points Passing the final module examination
6	Grading Module exam:Module exam (Study achievement, Oral examination, Weighting: 100 %)
7	Usability of the module M.Sc. CE
8	Grade bonus compliant to §25 (2)
9	References

To 1.:

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Instructor		Type Seminar	SWS 2
Course nr. 18-de-2119-se	Course name Seminar Key Skills		
Instructor		Type Seminar	SWS 2

Mo	dule name	cs and Technology						
Mo 18-	dule nr. dg-2070	Credit points 2 CP	Workload 60 h	Self-study 45 h	Module dur 1 Term	ation	Module cyc Every Seme	cle ester
Lar Ger	r guage rman/English		1	Module owner Prof. DrIng. Her	bert De Gerse	em		
1	Teaching co Learn and un background	ntent nderstand the theor to practical example	etical contexts in t es related to curre	he field of accelera nt projects in the fi	tor physics; a	pplicati	on of the the	oretical
2	Learning objectives The seminar addresses various topics relevant to accelerator physics and technology which in detail depend on the guest lecturers. So, insight into the current developments as well as into the different projects in the area is given. Moreover, the focus is put on the practical challenges arising during the design, construction and commissioning phase of the particular accelerator projects.							
3	Recommend Basic knowle	Recommended prerequisites for participation Basic knowledge in the field of accelerator physics and technology is useful, though not mandatory.						
4	Form of examination Module exam: • Module exam (Study achievement, Oral examination, Duration: 30 Min., Default RS)							
5	Prerequisite Passing the f	for the award of c	r edit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	evement, Oral exar	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. CE	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Coi	ırses							
	Course nr. 18-dg-2070-	Course name Se Accelerator Ph	sics and Technol	ogy				
	Instructor Prof. DrIng	Herbert De Gersen	n. Prof. Dr. rer. nat	. Norbert Pietralla	Ty	y pe eminar		SWS
Mo	Module name Drojost Sominar Application, Simulation and Control of Dowor Flogtronic Systems							
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Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18-	gt-2030	8 CP	240 h	180 h	1 Term	Every Semester		
Lan	i guage man/English			Module owner	d Griepentrog			
1	Tooching of	ntont		TIOL DIIIIg. Get	u unepennog			
1	 In an introductory meeting topics according to power electronics and control of drives are given to the students. During the seminary problems can be treated concerning the following topics: Simulation of power electronic systems plus analysis and evaluation of the models Implementing and startup of power electronic systems, test stand development plus measurement of characteristic parameters Modeling and simulation in the field of control of electrical drives Implementing and startup of controlled drive systems Suggested topics from the students are welcome 							
2	 Learning objectives Upon completion of the module, students will have learned: Autonomous familiarization with a given problem Selection and evaluation of appropriate development tools Familiarization with the used development tools Practical experience in power electronics and control of drives Logical presentation of the results in a report Presentation skills 							
3	Recomment Lecture "Lei	ded prerequisites fo stungselektronik 1" o	or participation or "Einführung En	ergietechnik" and g	ggf. "Regelungstechn	ik I" or similar		
4	Form of exa Module exa • Modul Report and/ the lecture.	mination n: e exam (Study achie or Presentation and/o	vement, Oral/writ or Colloquium. Th	tten examination, I le type of examinat	Default RS) ion will be announce	d in the beginning of		
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	m: e exam (Study achie	vement, Oral/writ	tten examination, V	Weighting: 100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, M.Sc. CE, B.S	c. und M.Sc. iST			
8	Grade bonu	is compliant to §25	(2)					
9	References Definition of	f project task						
Co ι	irses							

Course nr. 18-gt-2030-pj	Course name Project Seminar Application, Simulation and Control of Powe	er Electronic Systems	
Instructor M. Eng. Abdelmo	oumin Allioua, Prof. DrIng. Gerd Griepentrog	Type Project seminar	SWS 4

Mo	dule name	ed Flectronic System	ns Design A					
Mo 18-	dule nr. ho-2160	Credit points 4 CP	Workload 120 h	Self-study 90 h	Module of 1 Term	duration	Module cyc Every Seme	c le ester
Lar Eng	ıguage çlish			Module owner Prof. DrIng. Kla	us Hofman	ın		
1	Teaching co Research or written Docu	ontent iented Formulation umentation and Pres	of a Topic within entation; Team W	the area of Microo ork	electronics	System D	esign; Creati	on of a
2	Learning of A student is,	ojectives after successful con	npletion of this mo	odule, able to				
	1. gain a 2. write a	deep understanding in essay on the chose	of the chosen res en subject in a con	earch subject in the nprehesive form ar	e field of in d present t	tegrated e the outcom	lectronic syst	ems, ence
3	Recommended prerequisites for participation Advanced Digital Integrated Circuit Design, CAD Methods, Computer Architectures, Programming Know-How							
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 45 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c final module examin	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. etit - I	the module DT, M.Sc. etit - SAE,	M.Sc. WI-etit, M.	Sc. CE, M.Sc. iCE,	B.Sc. und I	M.Sc. iST		
8	Grade bonu	s compliant to §25	(2)					
9	References Topic-orient	ed Materials will be	provided					
Co	urses							
	Course nr.Course name18-ho-2160-seSeminar Integrated Electronic Systems Design A							
	Io no 2100 scDefinite integrated Electronic Systems Design NInstructorTypeSWSProf. DrIng. Klaus Hofmann2							

Mo Ser	Module name Seminar: Integrated Electronic Systems Design B							
Mo 18-	dule nr. ho-2161	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module of 1 Term	duration	Module cyc Every Seme	c le ester
Lar Eng	iguage glish			Module owner Prof. DrIng. Kla	us Hofman	ın		
1	Teaching co Research or written Docu	ontent iented Formulation umentation and Pres	of a Topic within entation; Team W	the area of Micro ork	electronics	System D	esign; Creati	on of a
2	Learning of A student is,	ojectives , after successful con	pletion of this mo	odule, able to				
	1. gain a 2. write a	deep understanding an essay on the chose	of the chosen res en subject in a cor	earch subject in the nprehesive form an	e field of in id present i	ntegrated e the outcom	lectronic syst ne to an audio	ems, ence
3	Recomment Advanced D	ded prerequisites for igital Integrated Circ	or participation ruit Design, CAD M	Aethods, Computer	Architectu	ures, Progr	amming Kno	w-How
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 45 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c final module examin	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral exa	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. CE, M.Sc	. iCE, B.Sc. und M	I.Sc. iST				
8	Grade bonu	s compliant to §25	(2)					
9	References Topic-orient	ed Materials will be	provided					
Coi	urses							
	Course nr.Course name18-ho-2161-seSeminar: Integrated Electronic Systems Design B							
	Instructor Type SWS Prof. DrIng. Klaus Hofmann 3							SWS 3

Mo	dule name					
Cor	nputational N	Adeling for the IGEN	M Competition			
Mo 18-	dule nr. kp-2100	Credit points 4 CP	Workload 120 h	Self-study 90 h	Module duration 1 Term	Module cycle Everv Semester
Lar	nguage	1 01		Module owner		
Eng	glish			Prof. Dr. techn. H	leinz Köppl	
1	 The International Genetically Engineered Machine (IGEM) competition is a yearly international student competition in the domain of synthetic biology, initiated and hosted by the Massachusetts Institute of Technology (MIT), USA since 2004. In the past years teams from TU Darmstadt participated and were very successfully in the competition. This seminar provides training for students and prospective IGEM team members in the domain of computational modeling of biomolecular circuits. The seminar aims at computationally inclined students from all background, but in particular from electrical engineering, computer science, physics and mathematics. Seminar participants that are interested to become IGEM team members could later team up with biologists and biochemists for the 2017 IGEM project of TU Darmstadt and be responsible for the computational modeling part of the project. The seminar will cover basic modeling approaches but will focus on discussing and presenting recent high-impact synthetic biology research results and past IGEM projects in the domain of computational modeling. Learning objectives 					
2	 2 Learning objectives Students that successfully passed that seminar should be able to perform practical modeling of biomolecular circuits that are based on transcriptional and translational control mechanism of gene expression as used in synthetic biology. This relies on the understanding of the following topics: Differential equation models of biomolecular processes Markov chain models of biomolecular processes Use of computational tools for the composition of genetic parts into circuits Calibration methods of computational models from experimental measurement Use of bioinformatics and database tools to select well-characterized genetic parts 					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul Report and/ the lecture.	amination m: le exam (Study achie or Presentation and/o	vement, Oral/writ or Colloquium. Th	ten examination, I e type of examinat	Default RS) ion will be announce	d in the beginning of
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exa • Modul	m: le exam (Study achie	vement, Oral/writ	ten examination, V	Weighting: 100 %)	
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. M	IedTec, B.Sc. und	M.Sc. iST		
8	Grade bonu	is compliant to §25	(2)			
9	References					
Coi	ırses					

Course nr. 18-kp-2100-se	Course name Computational Modeling for the IGEM Competition		
Instructor Prof. Dr. techn. H	leinz Köppl	Type Seminar	SWS 2

Mo Inte	Module name International Summer School 'Microwaves and Lightwaves'							
Mo 18-	dule nr. pr-2020	Credit points 4 CP	Workload 120 h	Self-study 90 h	Module d	luration	Module cyc Summer ter	c le rm
Lar Eng	ıguage çlish			Module owner Prof. Dr. rer. nat. Sascha Preu				
1	Teaching co This summe technology,	ontent er school covers the and optical commun	fundamentals ar ication systems wi	nd the latest devel th particular focus	opments o on the phy	f microwa vsical conce	ive electronic epts involved	cs, THz
2	 Learning objectives Students understand the presented research topics, e.g. topics of microwave engineering, THz engineering, and optical communications of related electronics the influence of the relevant properties of materials and of waveguides on signal processing. They gain inside into the latest developments in these fields. 							
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 30 Min., Default RS) 							
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral exa	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E, B.Sc. und M.Sc.	iST			
8	Grade bonu	s compliant to §25	(2)					
9	References A script (Eng	glish) will be distrib	ited or slides can	be downloaded.				
Cot	urses							
	Course nr. 18-pr-2020-	se International	Summer School "N	Aicrowaves and Lig	htwaves"			
	Instructor Prof. Dr. rer.	nat. Sascha Preu				Type Seminar		SWS 2

Мо	dule name					
One	e World Signa	l Processing Seminar	Series			1
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	pe-2090	4 CP	120 h	90 h	1 Term	Every Semester
Lan	iguage			Module owner	wine Decoverte	
Eng				Prof. DrIng. Ma	rius pesavento	
1	Teaching co This semina machine lea	ntent r series covers addre rning and optimizati	sses latest trends on.	in Signal processir	ng with focus on mol	vile communications,
2	 Learning objectives Students understand the presented research topics, e.g., the latest trends in Signal processing Communications Graph signal processing Machine learning for communications and data analysis Coexistence of radar and communications Compressed sensing and sampling theory Convex Optimization Students learn to prepare themselves for the participation in a scientific seminar based on reference to the scientific literature. Students learn to participate in scientific discussion. Students learn to summarize the main scientific findings and statements of the talk in a short written report. Students learn to summarize the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific findings of the talk in a scientific discussion and to defend the main scientific discussi					
3	Recommen	ded prerequisites fo	r participation			
4	Form of exa Module exa • Modul Report and/ the lecture.	mination n: e exam (Study achie or Presentation and/o	vement, Oral/wri or Colloquium. Th	tten examination, I le type of examinat	Default RS) ion will be announce	d in the beginning of
5	Prerequisite Passing the	e for the award of c r final module examina	redit points ation			
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)	
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. et	tit - KTS, B.Sc. un	d M.Sc. iST		
8	Grade bonu	s compliant to $\S{25}$	(2)			
9 Co1	References Slides can b URL for One	e downloaded. 9 World Signal Proces	ssing Seminar Ser	ies: https://www1	.se.cuhk.edu.hk/ htw	vai/oneworld

Course nr. 18-pe-2090-se	Course name One World Signal Processing Seminar Series		
Instructor Prof. DrIng. Ma	rius Pesavento, M.Sc. Raphael Müller	Type Seminar	SWS 2

Mo	dulo nomo					
Mu	ltimedia Com	munications Semina	r II			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	sm-2090	4 CP	120 h	90 h	1 Term	Every Semester
Ger	man/English			Prof. DrIng. Ral	f Steinmetz	
1	 Teaching content This seminar deals with current and upcoming trends relevant to the future development of multimedia communication systems. The educational objective of this seminar is to gain knowledge about future research trends in different areas. To this aim, an extensive literature research will be performed, as well as the writing-up of a report and the presentation of selected, high-quality research topics from current leading magazines, newspapers and conferences in the web technologies research area. Some potential topics are: Knowledge & Educational Technologies Self organizing Systems & Overlay Communication Mobile Systems & Sensor Networking Service-oriented Computing Multimedia Technologies & Serious Games 					
2	 Learning objectives Students shall acquire profound knowledge from current scientific publications, standards and literature on multimedia communication systems and applications which will build the future Internet. In so doing, the students will develop the following competencies: Search for and review relevant scientific literature. Analyse and evaluate complex technical and scientific information. Write technical and scientific abstracts and summary reports. Present technical and scientific information. 					
3	Recommen Solid know recommend	ded prerequisites fo ledge in computer co ed.	or participation	tworks. Lectures in	n Communication N	etworks I and II are
4	Form of exa Module exa • Modul Report and/ the lecture.	amination m: le exam (Study achie or Presentation and/o	vement, Oral/wri or Colloquium. Th	tten examination, I le type of examinat	Default RS) ion will be announce	d in the beginning of
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exame • Module	m: le exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)	
7	Usability of M.Sc. etit -	f the module DT, M.Sc. WI-etit, M.	.Sc. CE, M.Sc. iCE	, B.Sc. und M.Sc. i	ST	
8	Grade bonu	is compliant to §25	(2)			
9	References	on specific topic (sole	octed articles of in	urnale magazines	and conferences)	
Со	irses	on specific topic (sele	cicu articies or jo	amais, magazines,		

Course nr. 18-sm-2090-se	Course name Multimedia Communications Seminar II		
Instructor Prof. Dr. rer. nat. Biörn Scheuermann, Dr. Ing. Julian Zobel, M.Sc. Fridolin		Type Seminar	SWS 2
Siegmund, Prof.	DrIng. Ralf Steinmetz		

Mo Mu	dule name ltimedia Com	munications Semina	r I			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	sm-2300	4 CP	120 h	90 h	1 Term	Every Semester
Lan Ger	iguage man/English			Module owner Prof. DrIng. Rali	f Steinmetz	
1	 1 Teaching content The seminar investigates current and upcoming topics in multimedia communication systems, which are expected to be of utmost importance for the future evolution of the Internet and information technolgy in goal. The goal is to learn more about multimedia communication systems by studying, summarizing, and presenting top quality papers from recent high quality networking research journals, magazines, or conferences. The selection of topics corresponds to the research area of participating researchers. Possible topics are: Knowledge & Educational Technologies Self organizing Systems & Overlay Communication Mobile Systems & Sensor Networking Service-oriented Computing Multimedia Technologies & Serious Games 2 Learning objectives 					
2	 Learning objectives The students are actively studying cutting edge scientific articles, standards, and books about multimedia communication systems and applications, which are expected to be of utmost important for the future of the Internet. Students acquire competences in the following areas: Searching and reviewing of relevant scientific literature Analysis and evaluation of complex technical and scientific information Writing of technical and scientific summaries and short papers Presentation of complex technical and scientific information 					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul Report and/ the lecture.	amination m: e exam (Study achie or Presentation and/o	vement, Oral/wri or Colloquium. Th	tten examination, I le type of examinat	Default RS) ion will be announce	d in the beginning of
5	Prerequisite Passing the	e for the award of c	redit points ation			
6	Grading Module exan • Modul	m: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)	
7	Usability of M.Sc. MEC,	the module M.Sc. CE, B.Sc. und	M.Sc. iST			
8	Grade bonu	is compliant to §25	(2)			
9	9 References Depending on specific topic (selected articles of journals, magazines, and conferences).					
Coi	ırses					

Course nr. 18-sm-2300-se	Course name Multimedia Communications Seminar I		
Instructor Prof. Dr. rer. nat	. Björn Scheuermann, Dr. Ing. Julian Zobel, M.Sc. Fridolin	Type Seminar	SWS 2
Siegmund, Prof.	DrIng. Ralf Steinmetz		

Mo	dule name	o System Technology	7					
Mo 18-	dule nr. su-2080	Credit points 4 CP	Workload 120 h	Self-study 90 h	Module of 1 Term	luration	Module cyc Summer ter	cle rm
Lar Ger	nguage rman			Module owner Prof. Dr. rer. nat.	Andreas S	chürr	1	
1	Teaching co In this course subject relate	n tent e, the students produ ed to IT system devel	nce scientific repor opment and produ	ts from changing su ice a written report	ibject areas as well as a	. Each stu a final talk	dent has to ex with a presen	xplore a ntation.
2	2 Learning objectives Upon successful completion of the module, the students will be able to assess the reliability of information sources and explore an unknown topic under scientific aspects. The students learn to support the exploration by a literature research and to analyze the subject critically. They achieve the skills to present a definite subject in a written report as well as in an oral presentation.							
3	Recommended prerequisites for participationBasic knowledge in software engineering and programming languages							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation and/or Colloquium. The type of examination will be announced in the beginning of the lecture 							
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - DT, M.Sc	c. WI-etit, M.Sc. C	E, B.Sc. CE, M.Sc.	iCE, B.Sc.	und M.Sc.	iST	
8	Grade bonu	s compliant to §25	(2)					
9	References https://www	v.es.tu-darmstadt.de	/lehre/aktuelle-ve	eranstaltungen/sst-	S			
Co	urses							
	Course nr. 18-su-2080-s	Se Seminar Softv	vare System Techr	nology				
	Instructor Prof. Dr. rer.	nat. Andreas Schür	r, M.Sc. Alexej An	dres		Type Seminar		SWS 2

Mo Adv	dule name vanced Topics	in Statistical Signal	Processing			
Mo 18-	dule nr. zo-2040	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration 1 Term	Module cycle Winter term
Lan Eng	iguage glish			Module owner Prof. DrIng. Abdelhak Zoubir		
1	1 Teaching content The course covers the fundamentals of detection and estimation theory. These are extended by advanced topics in statistical signal processing. Applications are typically from the following areas: Detection in Radar Applications; Robust Estimation; Prediction, Filtering, and Tracking with the Kalman Filter; Sensor Array Signal Processing, Direction of Arrival Estimation, and Source Detection; Time-Frequency Analysis. Topics may change from semester to semester. The course includes a series of lectures followed by a supervised research seminar over approximately 2 months. The main topics covered are: Estimation theory Detection theory Robust estimation theory Seminar projects: e.g., microphone arrays/beamforming, localization and tracking, radar/ultrasonic imaging, acoustic source localization, estimation of number of sources 					
2	2 Learning objectives After completing the module, students will be able to work independently on advanced topics in signal processing and reproduce existing results. The students can present these results and discuss them scientifically					
3	Recommend DSP, general	ded prerequisites fo l interest in signal pr	or participation ocessing			· · · ·
4	Form of exa Module exar • Modul Report and/ the lecture.	mination n: e exam (Study achie or Presentation and/o	vement, Oral/writ or Colloquium. Th	ten examination, I e type of examinat	Default RS) ion will be announced	d in the beginning of
5	Prerequisite Passing the f	e for the award of c final module examina	redit points ation			
6	 6 Grading Module exam: • Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 					
7	Usability of M.Sc. WI-eti	the module it, M.Sc. CE, M.Sc. et	tit - KTS, M.Sc. M	edTec, M.Sc. iCE, I	3.Sc. und M.Sc. iST, I	M.Sc. etit - VAS
8	Grade bonu	s compliant to §25	(2)			
9	References					

- Lecture slides
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- S. Kassam. Signal Detection in Non-Gaussian Noise. Springer Verlag, 1988.
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Courses

00	arbeb			
	Course nr.			
	18-zo-2040-se	Advanced Topics in Statistical Signal Processing		
	Instructor Prof. DrIng. Abo	lelhak Zoubir, M.Sc. Pertami Kunz	Type Seminar	SWS 4

Mo Sig	dule name nal Detection	and Parameter Estim	nation			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Eng	iguage glish	0.01	270 11	Module owner Prof. DrIng. Abd	lelhak Zoubir	Summer term
1	Teaching co Signal deter many comm estimation v estimation s	ontent ction and parameter oon engineering opera vill be presented, allo schemes.	estimation are fu ations under a vari wing a better und	ndamental signal ety of names. In thi erstanding of how	processing tasks. In is course, the theory (and why) to design	fact, they appear in behind detection and "good" detection and
	 These lectures will cover: Fundamentals of Detection and Estimation Theory Hypothesis Testing: Bayesian/Ideal Observer/Neyman-Pearson Tests Receiver Operating Characteristics Uniformly Most Powerful Tests Matched Filter Estimation Theory: Types of Estimators Maxmimum Likelihood Estimators Sufficiency and the Fisher-Neyman/Factorisation Criterion Unbiasedness and minimum variance Fisher Information and the CRB Asymptotic properties of the MLE 					
2	Learning of After succes can design l In addition, adequately	bjectives ssful completion of th hypothesis tests and e students will be able present the methods	ne module, studen estimators for exis to review existing and results from o	ts know the basics sting problems and g work on detection existing publication	of detection and esti implement them in a and estimation indens and discuss them s	mation theory. They Matlab on their own. ependently. They can cientifically.
3	Recommen DSP, genera	ded prerequisites fo ll interest in signal pr	or participation ocessing			
4	Form of exa Module exa • Modul Report and/ the lecture.	amination m: le exam (Study achie ′or Presentation and/o	vement, Oral/wri or Colloquium. Th	tten examination, I te type of examinat	Default RS) ion will be announce	d in the beginning of
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			
6	Grading Module exa • Modu	m: le exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)	
7	Usability of M.Sc. WI-et	f the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. M	edTec, M.Sc. iCE, I	3.Sc. und M.Sc. iST,	M.Sc. etit - VAS
8	Grade bonu	is compliant to §25	(2)			

9	References				
	 Lecture slid Jerry D. Gi Press, 1996 S. Kassam. S. Kay. Fun 1993. S. Kay. Fun E. L. Lehm. E. L. Lehm. Leon-Garci 1994. P. Peebles. H. Vincent 1994. Louis L. Sc Education I Harry L. Va 2003. A. M. Zoub May 2004. 	les bson and James L. Melsa. Introduction to Nonparametric Der 5. Signal Detection in Non-Gaussian Noise. Springer Verlag, 198 damentals of Statistical Signal Processing: Estimation Theory. I annentals of Statistical Signal Processing: Detection Theory. I ann. Testing Statistical Hypotheses. Springer Verlag, 2nd editi ann and George Casella. Theory of Point Estimation. Springer a. Probability and Random Processes for Electrical Engineerin Probability, Random Variables, and Random Signal Principles. Poor. An Introduction to Signal Detection and Estimation. Spr harf. Statistical Signal Processing: Detection, Estimation, and POD, 2002. In Trees. Detection, Estimation, and Modulation Theory, volun ir and D. R. Iskander. Bootstrap Techniques for Signal Processi	tection with Application 8. Prentice Hall, Prentice Hall, 1998. on, 1997. Verlag, 2nd edition, 199 g. Addison Wesley, 2nd McGraw-Hill, 3rd edition inger Verlag, 2nd edition I Time Series Analysis. F ne I,II,III,IV. John Wiley ng. Cambridge Universit	s. IEEE 99. edition, 1, 1993. 1, Pearson & Sons, y Press,	
CO	urses	Course nome			
	Course nr.Course name18-zo-2050-seSignal Detection and Parameter Estimation				
	InstructorTypeSWSProf. DrIng. Abdelhak ZoubirSeminar4				

Mo Dat	dule name a Science II					
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	zo-2120	8 CP	240 h	180 h	1 Term	Winter term
Lan Eng	iguage llish			Module owner Prof. DrIng. Abd	lelhak Zoubir	
1	English Prof. DrIng. Abdelhak Zoubir 1 Teaching content The course covers the following topics: • Data Science Advanced Methods • Data Science Advanced Methods • Data Management + Big data frameworks • Statistical Learning - Recommender Systems • Deep Learning - Unsupervised Learning • Text data analysis • Text data analysis • Final application project. Flexibility to choose from list of projects or come up with own project. Examples: • Sound classification • Heart rate analysis • Activity recognition with acceleration data • Hyperspectral data • Image classification • Health survey					
2	Learning of After success strong practi novel metho	ojectives Sful completion of the ical relevance. They l ds in machine learni	e module, the stud nave become fami ng) and can apply	lents have an in-de liar with modern da 7 them in a project	pth understanding o ata science technolog with real world data	f data science with a ies (from big data to
3	Recommend Data Science	ded prerequisites fo e I (Lecture)	r participation			
4	Form of exa Module exar • Modul Report and/ the lecture.	mination n: e exam (Study achie or Presentation and/o	vement, Oral/writ or Colloquium. Th	tten examination, I le type of examinat	Duration: 90 Min., De ion will be announce	efault RS) d in the beginning of
5	Prerequisite Passing the f	e for the award of ca final module examination	r edit points ation			
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)	
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. WI-etit, M	1.Sc. CE, M.Sc. et	it - KTS, M.Sc. iCE,	B.Sc. und M.Sc. iST	, M.Sc. etit - VAS
8	Grade bonu	s compliant to §25	(2)			
9	References					

Lecture notes and slides can be downloaded here:

- http://www.spg.tu-darmstadt.de
- Moodle platform

Further reading:

- Wes McKinney: Python for Data Analysis, O'Reilly, 2017
- Christopher M. Bishop: Pattern Recognition and Machine Learning, 2011
- James, Witten, Hastie and Tibshirani, Introduction to Statistical Learning, Springer, 2017

Courses

Course nr. 18-zo-2120-se	Course name Data Science II		
Instructor DrIng. Christian	Debes	Type Seminar	SWS 4

2.4 Project Seminars

Mo	dule name	Pohotics and Compu	tational Intelligen	<u>co</u>		
Mo	dulo pr	Credit points	Workload	Solf study	Module duration	Modulo gyclo
18-	ad-2070	8 CP	240 h	180 h	1 Term	Summer term
Lar	guage			Module owner	-	
Ger	man			Prof. DrIng. Jür	gen Adamy	
1	Teaching co	ontent				
	The followin	g topics are taught i	n the lecture:			
	Industrial r	obots				
	1 Types	and applications				
	2. Geome	etry and kinematics				
	3. Dynan	nic model				
	4. Contro Mobile robo	ol of industrial robots				
	MODILE TODO					
	1. Types	and applications				
	2. Sensor	S	1			
	3. Enviro 4. Traject	nmental maps and n	hap building			
	Group projects are arranged in parallel to the lea			es in order to apply	the taught material	in practical exercises.
2	Learning of	ojectives			U	•
	Upon succes	sful completion of th	ie module, studen	ts are capable of:		
	1	a the basis slowers	a of inductivial wab			
	2. recalli	ng the dynamic equation	tions of industrial	robots and be able	to apply them to desc	cribe the dynamics of
	a giver	n robot,				
	3. stating	model problems and	d solutions to star	idard problems in 1	nobile robotics,	
	4. planin 5. organi	g a small project, zing the work load it	n a project team			
	6. search	ing for additional ba	ckground informa	tion on a given pro	ject,	
	7. creatin	ng ideas on how to so	olve problems aris	ing in the project,		
	8. writing	g an scientific report	about the outcom	e of the project		
	9. presen	ting the results of th	e project.			
3	Recommend	ded prereauisites fo	or participation			
		F F				
4	Form of exa	mination				
	Module exar	n:	1/	· · · · ·		
	• Modul Report and/	e exam (Study achie)	type of examinat	ion will be announ	red in the beginning	of the lecture
5	Drerennisit	of the award of c	redit noints		eeu in the beginning	or the lecture.
5	Passing the f	final module examination	ation			
6	Grading					
	Module exam	n:				
	• Modul	e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)	

7	Usability of the module M.Sc. MEC, M.Sc. WI-etit, M.Sc. CE, M.Sc. etit - AUT, M.Sc. MedTec, B.Sc. und M.Sc. iST					
8	Grade bonus compliant to §25 (2)					
9	References Adamy: Lecture notes (available for purchase at the FG office)					
Co	urses					
	Course nr.Course name18-ad-2070-pjProject Seminar Robotics and Computational Intelligence					
	InstructorTypeSWSProf. DrIng. Jürgen Adamy4					

Mo Pro	dule name ject Seminar .	Automatic Control S	ystems				
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
18-	ad-2080	8 CP	240 h	180 h 1 Term Winter term			
Ger	rman			Prof. DrIng. Jür	gen Adamy		
1	Teaching co In a small pr automation	o ntent roject group under t technology are work	he guidance of a s ed on.	cientific assistant,	individual projects f	rom a subject	area of
2	Learning of	ojectives		<u>.</u>			
	After attend	ing the module, a sti	ident is capable of	:			
	1. planin	g a small project,					
	2. organi 3. search	zing the work within ing for scientific bac	n a project team, kground informati	on on a given proj	ect,		
	4. creatir	ideas on how to so	olve problems aris	ing in the project,	,		
	5. presen 6. giving	a talk on the results in a	of the project.	nd			
			1 5				
3	Recomment	led prerequisites fo	or participation				
4	Form of exa Module exa • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/write type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	g of the lecture	е.
5	Prerequisite Passing the	e for the award of c inal module examin	redit points ation				
6	Grading						
	Module exar	n: e exam (Study achie	vement Oral/wri	tten examination A	Weighting: 100 %)		
	litiodul						
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	CE, M.Sc. etit - A	UT, B.Sc. und M.S	c. iST		
8	Grade bonu	s compliant to §25	(2)				
9	References Training cou	rse material					
Co	urses						
	Course nr. 18-ad-2080-	pi Project Semin	ar Automatic Cont	rol Systems			
	Instructor Prof. DrIng	. Jürgen Adamy, M.S	Sc. Linus Groß		Type Project s	eminar	SWS 4

Mo	dule name							
Ene	ergy Converter	rs and Electric Drives	Morthload	Solf study	Modulo	lumation	Modulo av	
18-	bt-2130	6 CP	180 h	135 h	1 Term	luiation	Every Seme	ester
Lar Ger	n guage rman/English	-		Module owner Prof. DrIng. Yves Burkhardt				
1	1 Teaching content From the topics of proposed scientific theses, subtasks are derived. Groups of two to four students will work on these subtasks under supervision of a tutor. The focus of the work can be either theoretical or experimental and contains scientific problems in the field of electric energy conversion and electric drives. For study program Mechatronics this corresponds to the Advanced Design Project. Independent from the individual topics, the topic "Design and testing of a small 3-phase induction machine" can always be chosen.							
2	Learning objectives Upon completion of the module, students will have acquired knowledge of: Energy Converters, Electric Drives, Control of Electric Drives, Teamwork, Writing Scientific Reports, Presentation							
3	Recommended prerequisites for participation Fundamentals on Electrical Engineering, Three-phase Systems, Mechanics; Lecture "Electrical Machines and Drives"							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. et	it - EET, M.Sc. WI	etit, M.Sc. CE				
8	Grade bonu	s compliant to §25	(2)					
9	References Depending of ment for ele	on the project task; m ctric Drive Systems",	nanuscripts from tl "Regelungstechni	ne lectures "Electric ik 1"	cal Machine	es and Driv	ves", "Motor c	levelop-
Co	ırses							
	Course nr. 18-bt-2130-j	Course nameojEnergy Convert	rters and Electric I	Drives				
	Instructor Prof. DrIng	. Yves Burkhardt				Type Project se	eminar	SWS 3

Mo Scie	Module name Science in Practice I								
Mo 18-	dule nr. dg-2130	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration 1 Term	Module cy Every Seme	cle ester		
Lar Ger	n guage rman/English			Module owner Prof. DrIng. Her	bert De Gersem				
1	Teaching co Acquiring ba	ntent sic scientific skills ba	ased on concrete e	xamples from the	literature.				
2	2 Learning objectives The students possess basic scientific skills. They are able to discover important literature for a given topic and to judge critically the corresponding content. They are familiar with numerical techniques, especially convergence studies relevant for praxis. The students are capable of analyzing errors within simulations and of judging accuracy requirements, e.g., with respect to errors in input data.								
3	 Recommended prerequisites for participation Good understanding of electromagnetic fields, knowledge about numerical simulation methods. 								
4	Form of exa Module exar • Module	mination n: e exam (Study achie	vement, Oral exar	nination, Duration	: 20 Min., Default RS	3)			
5	Prerequisite Passing the f	for the award of c inal module examin	redit points ation						
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)				
7	Usability of M.Sc. CE	the module							
8	Grade bonu	s compliant to §25	(2)						
9	References Material rela	ted to the topic is p	rovided.						
Coi	urses								
	Course nr. 18-dg-2130-	oj Course name Science in Pra	ctice I						
	Instructor Prof. DrIng	Herbert De Gersem			Type Project se	eminar	SWS		

Mo	dule name	o II					
Mo 18-	dule nr. dg-2140	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module durati 1 Term	on Module cy Every Sem	cle ester
Lar Ger	n guage rman/English			Module owner Prof. DrIng. Hei	bert De Gersem		
1	Teaching co Working on o	ntent lifferent scientific to	pics based on tecl	nniques acquired ir	n Science in Prac	rice I.	
2	2 Learning objectives The students are capable of succesfully working on new scientific topics from the numerical field simulation in a reasonable time. They are able to understand new methods, to implement them if necessary and to carry out simulations. Thereby methodologies discussed in Science in Practice I, especially concerning the solution of systems of equations, as well as convergence and error analysis are employed.						
3	 Recommended prerequisites for participation Good understanding of electromagnetic fields, knowledge about numerical simulation methods. 						
4	Form of exa Module exan • Module	mination h: e exam (Study achie	vement, Oral exar	nination, Duration	: 20 Min., Defau	lt RS)	
5	Prerequisite Passing the f	for the award of c nal module examin	redit points ation				
6	Grading Module exan • Module	n: e exam (Study achie	evement, Oral exar	nination, Weightin	g: 100 %)		
7	Usability of M.Sc. CE	the module					
8	Grade bonus	s compliant to §25	(2)				
9	References Material rela	ted to the topic is p	rovided.				
Cot	urses	1					
	Course nr. 18-dg-2140-j	Course nameojScience in Pra	ctice II				
	Instructor Prof. DrIng.	Herbert De Gersem	1		Type Proie	ct seminar	SWS

Mo	Module name Serious Cames Project Seminer									
Mo	Module nr. Credit points Workload Self-study Module duration Module cycle									
18-	de-2070	9 CP	270 h	195 h	1 Term	Every Seme	ester			
Lar Ger	nguage man/English			Module owner PD DrIng. Stefa	n Göbel					
1	Teaching co In this proje education, h The topics	ontent ct the students will d ealth and sports). relate to current re	lesign concepts an esearch questions	d implement proto	types in the field of s	erious games with partner	(e.g. in rs from			
	the games ir	ndustry and/or Serio	us Games users.			-				
2	2 Learning objectives After successfully attending the course, the students can conceptualize and prototypically implement practical tasks in the context of "Serious Games". Additionally they acquire practical knowledge in the area of project management, which they can apply to their own topic as well as transfer it to future projects. Besides, the students are able to present their findings in front of an audience applying a number of different presentation techniques and to actively participate in a scientific discussion on their topic.									
3	3 Recommended prerequisites for participation Programming skills (the language will depended on the topic and may be chosen at will for certain topics).									
4	Form of exa Module exa • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/wright type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture	e.			
5	Prerequisite Pass exam (1	e for the award of c 100%)	redit points							
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)					
7	Usability of M.Sc. CE, B.	the module Sc. CE, B.Sc. und M	.Sc. iST							
8	Grade bonu	s compliant to §25	(2)							
9	References									
Coi	urses									
	Course nr. 18-de-2070-	pj Serious Games	s Project Seminar							
	Instructor PD DrIng. S	Stefan Göbel			Type Project se	eminar	SWS 5			

Mo	dule name	ractical Application of	f Mechatronics					
Mo	dule nr. fi-2110	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
Lan Ger	nguage man	0.01	270 11	Module owner Prof. DrIng. Rol	f Findeisen		Winter term	.1
1	 Teaching content Teams of 2-4 students work on different mechatronic projects under the guidance of a project coordinator from the institute. The projects mainly cover the following subject areas: Modeling, analysis, and design of mechatronic systems Robust control design System analysis, supervision and fault diagnosis Modeling and identification Application areas are mechatronic actuators, machine tools, production lines, test benches, automobiles, quadrocopters. 							
2	2 Learning objectives After completing the project, the students will be familiar with the individual steps of investigating a mechatronic project. This includes in particular the compilation of a system specification as well as critical discussions and systematic selection of appropriate mechatronic solutions and their real technical implementation. Doing so, the students learn the practical application of mechatronic methods taught in the lectures to real world problems. Additionally, in this project course, the students are supposed to improve their professional skills. These skills include e.g. teamwork, presentation techniques and systematic information retrieval.							
3	 Recommended prerequisites for participation Lectures "System Dynamics and Automatic Control Systems I", "System Dynamics and Automatic Control Systems II" 							
4	Form of exa Module exa • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the l	beginning	of the lecture	e.
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. WI-etit, M.Sc.	CE, M.Sc. etit - A	UT, B.Sc. und M.S	c. iST			
8	Grade bonu	s compliant to §25	(2)					
9	References Handouts w	ill be distributed at s	tart of the project	(e.g. hints for writ	ing project	documen	tation, etc.)	
Cot	Course nr. 18-fi-2110-n	Course name Project Course	Practical Applica	tion of Mechatronic	CS			
	Instructor DrIng. Anto	on Savchenko, Prof. 1	DrIng. Rolf Finde	eisen		Type Project se	eminar	SWS

Mo	dule name	ntrol Engineering						
Mo	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cyc	cle
Lan Ger	nguage man	8 CP	240 II	Module owner Prof. DrIng. Rol	f Findeisen	l	Summer ter	[]]]
1	 Teaching content Teams of 2 - 4 students work on different control engineering projects under the guidance of a project coordinator from the institute. The projects mainly cover the following subject areas: Modelling, analysis and design of multivariable control systems Modelling, analysis and design of distributed parameter systems Robust control design System analysis, supervision and fault diagnosis Modelling and identification Application areas are machine tools, production lines, test benches, process control, automobiles. 							
2	2 Learning objectives After completing of this module the students will be familiar with the individual steps of investigating a control engineering project. This includes in particular the compilation of a system specification as well as critical discussions and systematic selection of appropriate control engineering solutions and their real technical implementation. Doing so the students learn the practical application of control engineering methods taught in the module "System Dynamics and Control Systems I" to real world problems. Additionally, in this module the students are supposed to improve their professional skills. These skills include e.g. teamwork, presentation techniques and systematic information retrieval.							
3	Recommend Lecture "Syst	ed prerequisites for em Dynamics and C	or participation Control Systems I"					
4	Form of exam Module exam • Module Report and/o	mination n: e exam (Study achie or Presentation. The	vement, Oral/wri type of examinat	tten examination, I ion will be announ	Default RS) ced in the) beginning	of the lecture	2.
5	Prerequisite Passing the fi	for the award of c nal module examina	redit points ation					
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. MEC, I	t he module M.Sc. WI-etit, M.Sc.	CE, M.Sc. etit - A	UT, B.Sc. und M.S	c. iST			
8	Grade bonus	s compliant to §25	(2)					
9	References Handouts wi	ll be distributed at s	tart of the project	(e.g. Hints for wri	ting a proje	ect docum	entation, etc.)
Cot	Course nr.	Course name	Control Engineer	ing				
	Instructor Prof. DrIng.	Rolf Findeisen	- Control Engineer	шу		Type Project se	eminar	SWS 4

Mo Pro	dule name ject Seminar I	Biomedical Optics						
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18-	fr-1020	8 CP	240 h	180 h	1 Term	Every Semester		
Lan Ger	nguage man/English			Module owner Prof. Dr. habil. Torsten Frosch				
1	 Teaching content This module is based on practical work on current, promising and trend-setting topics in biophotonics. We focus on applications of optical spectroscopy and microscopy in medical technology. Students will gain a deeper insight into practical work with lasers, optics, spectrometers, microscopes, etc. Participation in current research projects are possible, depending on the number of participants. The experimental results are evaluated using advanced techniques and methods of data processing and statistics and are documented in reports following scientific standards. 							
2	2 Learning objectives After successful completion of this module, students will be able to analyze and evaluate biophotonic methods and techniques. In addition, they have learned to plan and implement their own projects independently and collaborate in teams. They are able to apply experimental skills and advanced techniques and methods of data analysis. Depending on the task, students learn to independently analyze, improve, or build up optical setups from scratch. In addition, it is possible to program software for controlling devices and to analyze medically relevant samples. Furthermore, the measurement results are evaluated, presented, and interpreted in a scientific context. With the gained knowledge, students are able to critically analyze existing setups or instruments and develop their own approaches. In addition, students gain experience in preparing written reports according to scientific standards. They also practice presenting their work results to a professional or lay audience. Competencies such as the communication of specialist expertise to the public, the social relevance of							
3	Recomment Module Prin	ded prerequisites fo ciples of Optics for B	or participation iomedical Engine	ering				
4	Form of exa Module exa • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.		
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	 6 Grading Module exam: • Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 							
7	7 Usability of the module B.Sc. MedTec							
8	Grade bonu	s compliant to §25	(2)					
9	References							

Current scientific literature is recommended separately for the individual experiments. The following books can serve as a general reference:

- Bahaa E. A. Saleh und Malvin Carl Teich, Optik und Photonik, Wiley
- Eugen Hecht, Optik, Oldenburg Verlag
- Frank L. Pedrotti, Leno S. Pedrotti, Werner Bausch, Hartmut Schmidt, Optik für Ingenieure, Springer
- Herman Haken, Hans Christoph Wolf, Atom- und Quantenphysik, Springer
- Herman Haken, Hans Christoph Wolf, Molekülphysik und Quantenchemie, Springer
- Peter W. Atkins, Julio de Paula, Michael Bär, Physikalische Chemie, Wiley
- Wolfgang Demtröder, Laserspektroskopie 1&2, Springer

Courses

 A1000			
Course nr.	Course name		
18-fr-1020-pj	Project Seminar Biomedical Optics		
Instructor		Туре	SWS
Dr. rer. nat. And	reas Merian, Prof. Dr. habil. Torsten Frosch, M.Sc. Phil Reize	Project seminar	4

Mo Art	dule name ificial Intellige	nce in Medicine Cha	llenge				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle
Lar Ger	nguage rman	0.01	270 11	Module owner Prof. DrIng. Chr	istoph Hoog Antink	Livery Senie	.5101
1	Teaching co Within this r artificial inte of a disease given the sat dataset. In t	ntent nodule, students wi lligence (AI) in medi from medical signal me problem but will he end, a ranking of	ll work independe cine. The nature o s or data, the extr have to develop the best-performi	ently in small grou f the problem can b raction of a physio their own algorith ng algorithms is pr	ps on a given proble e the automatic class logical parameter, et ms, which will be ev ovided.	em from the re ification or pre- cc. All groups raluated on a	ealm of ediction will be hidden
2	2 Learning objectives Students can independently apply current AI / machine learning methods to solve medical problems. They have successfully independently developed, optimized and tested code that has withstood external evaluation. Graduates are enabled to apply methodological competencies, such as teamwork, in everyday professional life.						
3	 3 Recommended prerequisites for participation Basic programming skills in Python 18-zo-1030 Fundamentals of Signal Processing 						
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Beport and/or Presentation. The type of examination will be appounded in the beginning of the lecture 						
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)		
7	Usability of M.Sc. WI-eti	the module t, M.Sc. CE, B.Sc. M	edTec, M.Sc. Med	Tec, B.Sc. und M.S	Sc. iST		
8	Grade bonu	s compliant to §25	(2)				
9	References						
	 Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. The elements of statistical learning. Vol. 1. No. 10. New York: Springer series in statistics, 2001. Bishop, Christopher M. Pattern recognition and machine learning. springer, 2006. 						
Co	irses	Course norme					
	18-ha-2010-	pj Artificial Intell	igence in Medicin	e Challenge	Т		
	Instructor Prof. DrIng	. Christoph Hoog An	tink		Type Project s	eminar	SWS 4

Mo Pro	dule name ject Seminar I	Reconfigurable Syste	ms					
Mo	dule nr.	Credit points	Workload	Self-study	Module of 1 Term	duration	Module cy Every Seme	cle
Lan Ger	nguage man		100 H	Module owner Prof. DrIng. Chr	istian Hoc	hberger		
1	Teaching co Students wi be defined i particularly architecture Usually, the followed by	ontent Il work on their own ndividually for each means the extensio s as well as the prote course starts with a the practical part an	n or in two-person group. In this co- n, improvement, otypical implemen literature search d finally the result	n teams in this cou urse reconfigurable or adaptation of c ntation of application to get acquainted ts are presented in	urse. Topic e architect omponent ons on suc with the u a written 1	es and app ures will b s and tool h reconfig nderlying report and	lication conto e investigate s for reconfi urable archite architecture. a presentatio	ext will ed. This gurable ectures. This is on.
2	2 Learning objectives Successful students will know how to use reconfigurable systems within a given application context. They can use tools to program these systems and know how to map an application onto a given reconfigurable architecture. They are capable to evaluate the performance critical parts of an application. They understand the implications of different coding styles for a particular task.							
3	 3 Recommended prerequisites for participation Knowledge of reconfigurable devices (cf. course computer systems II) Knowledge of computer architecture (cf. course computer systems I) Solid programming skills (either in C or Java depending on the application scenario). 							
4	Form of exa Module exa • Modul Report and/	mination m: e exam (Study achie or Presentation. The	vement, Oral/writ	tten examination, I ion will be announ	Default RS) beginning	of the lecture	e.
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exa • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. etit - l	t he module DT, M.Sc. WI-etit, M	.Sc. CE, M.Sc. iCE	, B.Sc. und M.Sc. i	ST			
8	Grade bonu	is compliant to §25	(2)					
9	References Will be given	n to the students dur	ing the individual	seminar kick-off m	neeting.			
Coι	irses							
	Course nr. 18-hb-2040-	pj Project Semina	ar Reconfigurable	Systems				
	Instructor Prof. DrIng	. Christian Hochberg	ger			Type Project se	eminar	SWS 3

Mo Pro	dule name ject Seminar (Systems of Biomedic	al Engineering					
Mo 18-	dule nr. ha-2030	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module du 1 Term	uration	Module cyc Every Seme	cle ester
Lar Ger	nguage man/English			Module owner Prof. DrIng. Chr	ristoph Hoog	g Antink		
1	Teaching co Within this a systems of b software, e.g	ntent nodule, students wo iomedical engineer g. for automated dia	ork independently ing. The focus is o gnosis or therapy.	in small project te on the developmer	eams on ind at of system	ividual ta s consisti	sks from the ng of hardwa	field of are and
2	2 Learning objectives After completing the module, students will be able to independently abstract the technical requirements for a system in the area of biomedical engineering (e.g. for measuring and evaluating or simulating a physiological process). They can independently derive sub-projects from these requirements and create time schedules. They have successfully developed, optimized and tested a system comprising e.g. hardware and software. Graduates are enabled to apply methodological competencies, such as teamwork, in their everyday professional life.							
3	3 Recommended prerequisites for participation Interest in working independently on hardware and software							
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	evement, Oral/write type of examinat	tten examination, I ion will be announ	Default RS) ced in the b	eginning	of the lecture	2.
5	Prerequisite Passing the f	e for the award of c	r edit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	evement, Oral/wri	tten examination, V	Weighting: 1	100 %)		
7	Usability of M.Sc. CE, M	the module .Sc. MedTec, B.Sc. ι	ınd M.Sc. iST					
8	Grade bonu	s compliant to §25	(2)					
9	References Leonhardt, S nik und auto	., & Walter, M. (Eds. matisierte Therapie). (2016). Medizir führung. Springer	itechnische System -Verlag.	e: Physiolog	ische Gru	ndlagen, Gera	ätetech-
Co	urses							
	Course nr. 18-ha-2030-	pj Course name Project Semin	ar Systems of Bior	nedical Engineerin	g			
	Instructor Prof. DrIng	. Christoph Hoog Ar	ntink			Type Project se	minar	SWS 4

Mo	dule name	Network calculation						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle	
18-	hs-2110	6 CP	180 h	135 h	1 Term	Every Seme	ester	
Lar Ger	rman			Prof. DrIng. Jut	ta Hanson			
1	Teaching co As an introd program app The participa electrical po	ontent uction, the principles blicable for network o ants then work indep wer supply system.	s of modeling elect calculation is prese pendently on a giv	trical networks will ented and applied en problem from tl	be presented. Subse by the participants in he field of modeling	equently, a sin 1 computer ex and simulatio	ulation cercises. n in the	
2	 Learning objectives Upon successful completion of the module, students were taught: Knowledge of a simulation program used for network calculation Elaboration of a given technical problem from the field of network planning or calculation Independent elaboration of the necessary investigations and conception of corresponding simulations Logical and concise presentation of the results in a report in the format of a scientific paper 							
3	3 Recommended prerequisites for participation Lectures " Power Systems" I und II							
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ	tten examination, l ion will be announ	Default RS) ced in the beginning	g of the lecture	e.	
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting: 100 %)			
7	Usability of M.Sc. ESE, M	the module M.Sc. etit - EET, M.S	c. WI-etit, M.Sc. C	CE				
8	Grade bonu	s compliant to §25	(2)					
9	References Script, progr	am description, exe	rcise task, project	task topic.				
Co	urses							
	Course nr. 18-hs-2110-	pj Course name Project Semin	ar Network calcul	ation				
	Instructor Prof. DrIng	. Jutta Hanson			Type Project s	eminar	SWS 3	

Mo	dule name								
Pro Mo	ject Seminar . dule nr.	Advanced µWave Cor Credit points	mponents & Anter Workload	nnas Self-study	Module d	luration	Module cy	cle	
18-	jk-2060	8 CP	240 h	180 h	1 Term		Every Seme	ester	
Lan Ger	nguage man/English			Module owner Prof. DrIng. Rol	f Jakoby				
1	 Groups of 2-3 students per project. Students work out a well defined fundamental or actual research- related problem. The projects will be actualized in each cycle being offered and introduced at the beginning. Each group will be supervised individually. The projects comprises modern antennas for multitudinous applications, electronically-steerable antennas, RFIDs, RF sensors, adaptive tunable components such as matching networks, filter, passive mixer and modulator for next-generation mobile terminals and sensor systems. Learning objectives 								
	 Research-oriented Project Seminar in groups of 2-3 students per project with individual supervision. Students will learn how to solve scientific hardware-oriented problems working out concepts how to design, realize and characterize RF devices how to use commercial software and characterization tools to evaluate and discuss their work in the context of the state-of-art in this field to write a brief scientific report about their work to present and discus their results at the end of the Project Seminar 								
3	Recomment Fundamenta	ded prerequisites fo lls of Microwave Eng	or participation ineering I and An	tennas and Adaptiv	e Beamfor	ming			
4	Form of exa Module exa • Modul	mination n: e exam (Study achie	vement, Oral exar	nination, Duration	: 30 Min., I	Default RS	3)		
5	Prerequisite Passing the	e for the award of c	redit points ation						
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)				
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E					
8	Grade bonu	s compliant to §25	(2)						
9	9 References Publications will be hand out to them. Software and characterization tools as well as tools to realize RF devices are available.								
Co ι	urses	1							
	Course nr. 18-jk-2060-j	Course nameojProject Semina	ar Advanced µWay	ve Components & A	ntennas				
	Instructor Prof. DrIng	. Rolf Jakoby, DrIng	. Martin Schüßler			Type Project se	eminar	SWS	
Mo	dule name								
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Bio	medical Micro	Credit points	Sensors and Appli	cators	Module durs	ation	Module cv	clo	
18-	jk-2120	6 CP	180 h	135 h	1 Term		Summer ter	rm	
Lar Ger	iguage man		I	Module owner Prof. DrIng. Rol	f Jakoby	I.			
1	Teaching co Application microfluidice tions of micr field propag supervision.	ontent of biomedical senso s as tool for microwa rowaves, microwave a ation in biological tis	rs based on elective-based sensing of applicators for imassues and those ap	romagnetic waves of fluids, electropor ging, diagnosis and plications. Work or	and their adva ation; diagnos l treatment; co a a current scie	antages itic and to omputer entific is	. Fundament therapeutic t-based mether sue with inc	ntals of applica- nods for dividual	
2	Learning ol Students un the advanta concerning r Practical exa design and example wit frame of a c paper about	bjectives derstand the physica ges of the use of mi nicrowave-based diag imples lead to streng characterization of r h such a simulation s coordinated project v it. The results are project	al basics of microw crowaves compar- gnostics and treatn htening these abili nicrowave applica software. Students work. They can su resented and discu	vave-based sensors ed to other technon nents and can hand ities. Students know tors. They gained is are able to solve n immarize the curr issed in a final pres	for biomedicit logies. They le le the physical v computer-ba experience wh nanageable sci ent state of th sentation.	ne. The know fie context sed simu hile wor entific p e art an	y are able to elds of appli of used app ulation tools king on a p problems with ad write a so	o derive ications licators. s for the ractical thin the cientific	
3	Recommended prerequisites for participation Biomedical Microwave Engineering								
4	Form of exa Module exa • Modul The type of and an oral	mination n: e exam (Study achie examination will be a examination (30 mir	vement, Oral exar innounced in the f nutes).	nination, Duration irst lecture. Possibl	30 Min., Defa e types include	ault RS) e presen	tation (10 n	ninutes)	
5	Prerequisite Passing the	e for the award of c final module examination	redit points ation						
6	Grading Module exan • Modul	m: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)				
7	Usability of M.Sc. WI-et	the module it, M.Sc. MedTec							
8	Grade bonu	is compliant to §25	(2)						
9	9 References Necessary publications and recommended literature as well as simulation software tools are provided.								
Co ι	ırses								
	Course nr. 18-jk-2120-j	Course nameojBiomedical Mi	crowave-Theranos	stics: Sensors and A	pplicators				
	Instructor Prof. DrIng	. Rolf Jakoby, DrIng	Instructor Type SWS Prof. DrIng. Rolf. Jakoby. DrIng. Martin Schüßler Project seminar 3						

Mo Adv	Module name Advanced Project Seminar Particle Accelerator Technology							
Mo 18-	dule nr. kb-2030	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module	duration	Module cyc Every Seme	c le ester
Lar Ger	iguage man/English			Module owner Prof. DrIng. Hai	rald Klingb	eil		
1	Teaching co Work on a co specific prob	n tent omplex, research-ori lem, measurement a	ented project in th spects, analytical	ne field of particle a aspects, and simula	accelerator ation aspec	technolog cts will be i	y. Depending included.	; on the
2	Learning of Students wi techniques, modeling an Students are	jectives Il be able to solve co analytical approache d simulation errors. able to organize tea	omplex research-c es or simulation m They know how to mwork.	priented engineerin nethods. They are a present the result	ng problem able to esti ts on a scie	ns with diff mate meas ntific level	ferent measu surement erro in talks and	rement ors and a paper.
3	Recommend Good unders	led prerequisites for standing of electrom	or participation agnetic fields, bro	ad knowledge of d	ifferent ele	ectrical eng	ineering disc	iplines.
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. CE, M	the module .Sc. etit - CMEE						
8	Grade bonu	s compliant to §25	(2)					
9	References Suitable mat	erial is provided bas	ed on specific pro	blem.				
Co	Courses							
	Course nr.Course name18-kb-2030-pjAdvanced Project Seminar Particle Accelerator Technology							
	Instructor Prof. DrIng Christoph W	g. Harald Klingbeil, egmann	, M.Sc. Sebastiar	ı Orth, M.Sc. Yi J	in, M.Sc.	Type Project se	eminar	SWS 4

Mo Pro	Module name Project Seminar Application in High-Voltage Technology								
Mo 18-	dule nr. kc-2040	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module d	uration	Module cyc Every Seme	cle ester	
Lar Ger	nguage rman			Module owner Prof. Dr. Myriam	Koch				
1	Teaching co Realization o	o ntent of a Project from the	Design to the Imp	plementation of Hig	gh Voltage S	Setups			
2	Learning of The students specification have success the beginnin	jectives can apply the meth up to design and ty fully experienced tea g.	odology of design ype tests and doct am work and self-i	and development umentation of equ ndependently deve	from the ve ipment in h eloped, built	ry first cus iigh-voltag t and teste	stomer requir ge technolog ed a real devi	rements y. They ce from	
3	Recomment High-voltage	led prerequisites for technology I and II	or participation , Power Laborator	y I or II					
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation. The type of examination will be announced in the beginning of the lecture. 								
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation						
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)			
7	Usability of M.Sc. etit - I	the module EET, M.Sc. WI-etit, N	1.Sc. CE						
8	Grade bonu	s compliant to §25	(2)						
9	9 References depending on actual project								
Cot	Courses								
	Course nr. 18-kc-2040-	Course name pj Project Semin	ar Application in I	High-Voltage Techn	ology				
	InstructorTypeSWSM.Sc. Michael Kempf, Prof. Dr. Myriam KochProject seminar3								

Mo Pro	dule name iect seminar <i>l</i>	Applications of Light	ng Engineering					
Mo 18-1	dule nr. kh-2051	Credit points 5 CP	Workload 150 h	Self-study 105 h	Module d 1 Term	luration	Module cyc Every Seme	c le ester
Lan Ger	iguage man/English			Module owner Prof. DrIng. Tra	n Quoc Kha	anh		
1	Teaching co The project generation, technology;	ontent seminar deals with t perception and cog physical and psycho	he following subjo nition of the visu physical light mea	ects: automotive lig al stimulus (lumin surement; illumina	ghting, inte naires, disp ating engine	erior lightin plays, proj eering, col	ng, exterior li jection); LED lor perceptior	ighting; D/OLED n.
2	Learning of Upon comple independent	jectives etion of the module, :ly in project teams o	students will be al or on their own.	ble to apply interdia	sciplinary tl	hinking in	lighting engi	neering
3	Recomment Lighting Tec	led prerequisites fo hnology I-II	or participation					
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the l	beginning	of the lecture	2.
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MEC,	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, B.Sc. und M.So	c. iST, M.So	c. etit - VA	S	
8	Grade bonu	s compliant to §25	(2)					
9	 References Lecture notes of Lighting Technology I (Khanh); Lecture slides of our Laboratory; Book "LED Lighting: Technology and Perception" (Khanh et al., Wiley); Book "Farbwiedergabe" (Khanh et al., Pflaum-Verlag); specific literature depending on the topic, publications. 							
Coι	Courses							
	Course nr. 18-kh-2051-	pj Project semina	ar Applications of	Lighting Engineeri	ng			
	InstructorTypeSWSProf. DrIng. Tran Quoc Khanh3							

Mo	Module name							
Pro	ject seminar A	dvanced Application	ns of Lighting Eng	solf study	Modulod	lunation	Modulo av	a1a
18-	kh-2052	5 CP	150 h	105 h	1 Term	luration	Every Seme	ester
Lar Ger	iguage man			Module owner Prof. DrIng. Tra	n Quoc Kha	anh		
1	Teaching co For the proje light for the a lighting; gene technology; j virtual reality material acqu project semin	ntent ct seminar, a questic automated car, interi- eration, perception a physical and psycho / tests for light simu nired in the course o nar "Lighting Applica	on from the follow for and exterior lig nd cognition of the physical light mea lations. The aim of f study in the form ations" are applied	ing topics can be a hting; Smart Lighti visual stimulus (lu surement technolo of this project semin of a project work. l and deepened.	ddressed: A ing; Humar minaires, d gy; lighting nar is the p The funda	Automotive n Centric L isplays, pro g technolo rractical im mentals of	e lighting tech ighting (HCL ojection); LEI gy, color pero plementation f the module a	nnology,); plant D/OLED ception, n of the and the
2	2 Learning objectives Upon completion of the module, students will be able to plan, implement and validate lighting technology issues. In addition, they will have learned how to abstract questions, communicate information in a project-dependent manner, and present their results.							
3	3Recommended prerequisites for participationLighting Technology I-II, Project seminar Applications of Lighting Engineering							
4	Form of exam Module exam • Module Report and/o	mination 1: 2 exam (Study achie or Presentation. The	vement, Oral/writ	tten examination, I ion will be announ	Default RS) ced in the l	beginning	of the lecture	2.
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. MEC, I	the module M.Sc. etit - SAE, M.S	Sc. WI-etit, M.Sc.	CE, B.Sc. und M.So	e. iST, M.So	c. etit - VA	S	
8	Grade bonus	s compliant to §25	(2)					
9	9 References Lecture notes of Lighting Technology I (Khanh); Lecture slides of our Laboratory; Book "LED Lighting: Technology and Perception" (Khanh et al., Wiley); Book "Farbwiedergabe" (Khanh et al., Pflaum-Verlag); specific literature depending on the topic, publications.							
Cou	ırses							
	Course nr. 18-kh-2052- _I	Course nameojProject semina	ar Advanced Appli	cations of Lighting	Engineerin	ıg		
	InstructorTypeSWSProf. DrIng. Tran Ouoc Khanh3							

Mo	dule name							
Pro	ject seminar S	pecial Applications	of Lighting Engine	ering				
Mo	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cyc	cle
Lar Ger	nguage man/English	0 Cr	240 11	Module owner Prof. DrIng. Tra	n Quoc Kh	anh	Every Seme	:5101
1	Teaching co For the project for autonomo lighting; gen technology; p reality tests to knowledge a which also ta	ntent ct seminar a question us cars, interior light eration, perception physical and psychop for light-simulation. cquired during the kes up topics beyon	n from the followin ring, exterior lighti and cognition of physical light meas . The objective of study in the form d the lectures.	ng subject areas car ng; smart lighting; l visual stimuli (lum surement; illuminat this project semina of research or pro	h be worked human cen inaires, dis ting engine ar is the pr ject work i	d on: Autor tric lighting splays, pro- sering, colo ractical im n an intere	motive lightin g (HCL); horti jection); LED or perception, plementatior disciplinary o	ig, light iculture)/OLED , virtual 1 of the context,
2	2 Learning objectives Upon successful completion of the module, students have learned the approach, implementation and validation or investigation of interdisciplinary lighting issues. This requires an introduction into topics that go beyond the subject area of the lectures. Usually, this includes the selection of suitable illuminants, the development of electronic hardware, the use of photometric measuring instruments as well as the conception, execution and evaluation of studies. In addition, students learn to abstract questions, to develop research questions, to communicate information depending on the project, and to present and discuss results.							
3	Recommended prerequisites for participation Lighting Technology I-II, Project seminar Applications of Lighting Engineering							
4	Form of exam Module exam • Module Report and/o	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ	tten examination, I ion will be announ	Default RS) ced in the) beginning	of the lecture	2.
5	Prerequisite Passing the fi	for the award of c nal module examination	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. etit - S	the module AE, M.Sc. WI-etit, N	A.Sc. CE, B.Sc. un	d M.Sc. iST, M.Sc.	etit - VAS			
8	Grade bonus	s compliant to §25	(2)					
9	References Lecture notes and Perceptio depending or	of Lighting Technolo on" (Khanh et al., W n the topic, publicat	ogy I (Khanh); Lec ïley); Book "Farbv ions.	ture slides of our La viedergabe" (Khanł	boratory; E 1 et al., Pfla	Book "LED I aum-Verlag	Lighting: Tech g); specific lit	nnology erature
Co ι	ırses	1						
	Course nr. 18-kh-2053- _I	Course nameojProject semina	ar Special Applicat	ions of Lighting En	gineering			
	Instructor Prof. DrIng.	Tran Quoc Khanh				Type Project se	eminar	SWS 3

Mo Pro	dule name iect Seminar	Wireless Communica	itions					
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cyc	cle
Lar Eng	nguage	o Cr	240 11	Module owner Prof. DrIng. Ani	a Klein		Summer ter	1111
1	Teaching co Solving spec processing a research top working on organizing a dealing with practical wo scientific pre defending th	ontent cial problems concer as well as problems c bics of the lab); the project in teams and structuring of a p a scientific publication rk on a complex task esentation of the resu- ne work in an oral di	ning wireless com concerning the ner (2-3 students); project; ns, reading up the ;; ilts (report/presen scussion including	munications (prob twork are possible, theoretical backgr ntation);	lems conce topics will ound of the	erning sigr l be define e task;	nal transmissi ed out of the	ion and current
2	 2 Learning objectives After completion of the course, students possess the ability to classify and analyze special problems concerning wireless communications, the knowledge to plan and organize projects with temporal limitation, the capability to set up and test methodologies for analysis and simulation environments, skills to evaluate and present achieved results and achieved conclusions. 3 Becommended prerequisites for participation 							
3	Recommended prerequisites for participation Previous knowledge in digital communications, signal processing, wireless communication.							
4	Form of exa Module exa • Modul Report and/	amination m: e exam (Study achie 'or Presentation. The	vement, Oral/wri type of examinat	tten examination, I ion will be announ	Default RS) ced in the l	beginning	of the lecture	2.
5	Prerequisite Passing the	e for the award of c final module examination	redit points ation					
6	Grading Module exa • Modul	m: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting:	100 %)		
7	Usability of M.Sc. WI-et	the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E, B.Sc. und M.Sc.	iST, M.Sc.	etit - VAS		
8	Grade bonu	is compliant to §25	(2)					
9	References Literature w	vill be announced du	ring the course.					
Co ι	irses	Courses marries						
	18-kl-2040-j	pj Project Semina	ar Wireless Comm	unications				
	Instructor Prof. DrIng	. Anja Klein, M.Sc. S	umedh Dongare			Type Project se	eminar	sws 4

Mo	dule name	Spintropia Dovigos						
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-	me-2030	6 CP	180 h	135 h	1 Term		Every Seme	ester
Lar	nguage			Module owner				
Ger	man/English			Prof. Dr. rer. nat.	Markus M	leinert		
1	Teaching co In the project range from fabrication a sensor device fabrication funder clean	ontent ct seminar, students l the development of and characterization es or memory cell (M From the deposition of room conditions.	have the opportur measurement sys of functional thir RAM) prototypes. of atomically thin	aity to deal with va stems for the chara a film systems, to t Students gain valua film systems to the	rious aspec acterizatio he lithogra able insigh eir basic ch	cts of spint n of spint aphic prepa ts into the o aracteriza	ronic devices conic devices, aration of spi entire chain o tion and lithc	. These , to the intronic f device ography
2	Learning ol Students lea Individual p the form of a technology t	Djectives rn the basics of fabric rojects are carried ou a project work and le to answer concrete qu	ation and applicat at in small groups. earn and deepen the uestions from rese	ion of spintronic de The students deep neir knowledge in t arch and developn	evices as sen ben the ma the applica nent.	nsors or ma terial learr tion of elec	agnetic memo ned in the lect ctronic measu	ory cells. tures in irement
3	 Recommended prerequisites for participation Introduction to Spintronics (desirable) Materials of Electrical Engineering (desirable) 							
4	Form of exa Module exa • Modul Report and/	mination m: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS ced in the) beginning	of the lecture	e.
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. CE, M	the module I.Sc. iCE, B.Sc. und M	A.Sc. iST					
8	Grade bonu	s compliant to §25	(2)					
9	9 References Lecture notes Introduction to Spintronics (Meinert), subject-specific literature and publications.							
Cot	Courses							
	Course nr. 18-me-2030	-pj Project semina	ar Spintronic Devi	ces				
	Instructor Prof. Dr. rer.	nat. Markus Meiner	t			Type Project se	eminar	SWS 3

Mo Pro	Module name Project Seminar Emerging Topics in Sensor Array and Multichannel Processing							
Mo 18-	dule nr. pe-2040	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module d	luration	Module cyc Winter tern	cle n
Lar Eng	iguage glish			Module owner Prof. DrIng. Ma	rius Pesave	nto	I	
1	Teaching co This project- tensor data The specific research fiel	ontent seminar addresses n representations. thematic focus of the d. The topics will be	ew trends in sense seminar will be a announced on the	or array and multic dapted from year to e course website w	channel pro o year accor ell in advar	cessing wi rding to th nce.	ith multidime e latest trend	ensional s in the
2	Learning of Students wil	jectives l understand theory,	algorithms and a	pplications of sense	or array and	d multicha	nnel system.	
3	Recommend Basic knowle	led prerequisites fo edge in linear algebr	or participation a.					
4	Form of exa Module exar • Modul	mination n: e exam (Study achie	vement, Oral exai	nination, Duration	: 40 Min., I	Default RS	;)	
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. WI-eti	the module it, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E, B.Sc. und M.Sc.	iST, M.Sc.	etit - VAS		
8	Grade bonu	s compliant to §25	(2)					
9	 References Harry L. Van Trees, Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory, John Wiley & Sons, 2002. References include the latest scientific publications, seminars and books. 							
Co	Courses							
	Course nr. 18-pe-2040-	pj Project Semina	ar Emerging Topic	es in Sensor Array a	and Multich	nannel Pro	cessing	
	InstructorTypeSWSProf. DrIng. Marius Pesavento, M.Sc. Raphael MüllerProject seminar4							

Mo Pro	Module name Project Seminar Emerging topics in MIMO Communication Networks								
Mo 18-	dule nr. pe-2050	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module dura 1 Term	ation	Module cyc Summer ter	cle rm	
Lar Eng	iguage glish			Module owner Prof. DrIng. Ma	rius Pesavento				
1	Teaching co This project communicat The specific wireless com	ntent seminar addresses on systems. thematic focus of th munications. The to	new trends in M e seminar will be pics will be annot	IIMO communicat adapted from yea inced on the course	ions for the n r to year accor e website well	ext gen ding to in adva	eration of v the latest tr nce.	vireless ends in	
2	Learning ob Students wil MIMO system	jectives l learn the fundamo ns and 5 G mobile c	ental concepts, pr ommunication net	ocedures, theories tworks by the lates	, algorithms a t scientific pub	nd appl	ications of I s.	Massive	
3	Recommend	led prerequisites fo	or participation						
4	 Form of examination Module exam: Module exam (Study achievement, Oral examination, Duration: 40 Min., Default RS) 								
5	Prerequisite Passing the f	for the award of c	redit points ation						
6	Grading Module exam • Module	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)				
7	Usability of M.Sc. WI-eti	the module t, M.Sc. CE, M.Sc. e	tit - KTS, M.Sc. iC	E, B.Ed. etit, B.Sc.	WI-etit, M.Sc.	etit - VA	AS		
8	Grade bonu	s compliant to §25	(2)						
9	9 References References include the latest scientific publications, seminars and books.								
Coi	Courses								
	Course nr. 18-pe-2050-j	Course name pj Project Semin	ar Emerging Topic	es in MIMO Comm	unication Netw	vorks			
	InstructorTypeSWSProf. DrIng. Marius Pesavento4								

Mo Adv	Module name Advanced Project Seminar Electromagnetic CAD							
Mo 18-	dule nr. sc-2020	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module of 1 Term	duration	Module cyc Every Seme	cle ester
Lar Ger	n guage rman/English			Module owner Prof. Dr. rer. nat.	Sebastian	Schöps		
1	Teaching co Work on a co software or s	ntent omplex research-ori elf-written code.	ented project in n	umerical field calc	ulation usi	ng comme	ercial tools, ir	n house
2	2 Learning objectives Students will be able to simulate independently complex research-oriented engineering problems with numerical field simulation software. They are able to assess whether the project requires research and/or development and find the relevant literature on this independently. They know how to present the results on a scientific level in talks and a paper. Students are able to organize teamwork.							
3	Recommend Good unders	ed prerequisites for the tending of electrom	or participation agnetic fields, kno	wledge about num	nerical simu	ilation me	thods.	
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, Default RS) Report and/or Presentation. The type of examination will be announced in the beginning of the lecture. 							
5	Prerequisite Passing the f	for the award of c nal module examin	e redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	evement, Oral/wri	tten examination, ^v	Weighting:	100 %)		
7	Usability of M.Sc. CE, M	the module Sc. etit - CMEE						
8	Grade bonu	s compliant to §25	(2)					
9	9 References Documents will be made available via Moodle if necessary.							
Co	Courses							
	Course nr. 18-sc-2020-p	j Course name Advanced Pro	ject Seminar Elect	romagnetic CAD				
	InstructorTypeSWSProf. Dr. rer. nat. Sebastian SchöpsProject seminar4							

Mo	dule name							
Mu Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
18-	sm-2080	6 CP	180 h	135 h	1 Term	Every Semester		
Lar Gei	nguage rman/English			Module owner Prof. DrIng. Ral	f Steinmetz			
1	Teaching co	ontent		0				
	 The course deals with cutting edge scientific and development topics in the area of multimedia communication systems. Besides a general overview it provides a deep insight into a special scientific topic. The topics are selected according to the specific working areas of the participating researchers and convey technical and scientific competences in one or more of the following topics: Network planning and traffic analysis Performance evaluation of network applications Discrete event simulation for network services Protocols for mobile ad hoc networks / sensor networks Infrastructure networks for mobile communication / mesh networks Context-aware communication and services Peer-to-peer systems and architectures Content distribution and management systems for multimedia / e-learning Multimedia authoring and re-authoring tools Web service technologies and service-oriented architectures Applications for distributed workflows 							
2	 Applications for distributed workflows Learning objectives The ability to solve and evaluate technical and scientific problems in the area of design and development of future multimedia communication networks and applications using state of the art scientific methods shall be acquired. Acquired competences are: 							
3	 3 Recommended prerequisites for participation Keen interest to develop and explore challenging solutions and applications in cutting edge multimedia communications systems using scientific methods. Further we expect: Solid experience in programming Java and/or C (C/C++) Solid knowledge in object oriented analysis and design Basic knowledge of design patterns, refactoring and project management Solid knowledge in computer communication networks are recommended Lectures in Communication Networks I (II, III, or IV) are an additional plus 							
4	Form of exa Module exa • Modul Report and/	amination m: le exam (Study achie ′or Presentation. The	vement, Oral/writ type of examinat	ten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.		
5	Prerequisit	e for the award of c	redit points					

	Passing the final module examination							
6	GradingModule exam:Module exam (Study achievement, Oral/written examination, Weighting: 100 %)							
7	Usability of the M.Sc. etit - DT, M	module 1.Sc. WI-etit, M.Sc. CE, B.Sc. und M.Sc. iST						
8	Grade bonus co	mpliant to §25 (2)						
9	References Each topic is covered by a selection of papers and articles. In addition we recommend reading of selected chapters from following books: • Andrew Tanenbaum: "Computer Networks". Prentice Hall PTR (ISBN 0130384887) • Raj Jain: "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling" (ISBN 0-471-50336-3) • Joshua Bloch: "Effective Java - Programming Language Guide" (ISBN-13: 978-0201310054) • Erich Gamma, Richard Helm, Ralph E. Johnson: "Design Patterns: Objects of Reusable Object Oriented Software" (ISBN 0-201-63361-2) • Martin Fowler: "Refactorings - Improving the Design of Existing Code" (ISBN-13: 978-0201485677) • Kent Beck: "Extreme Programming Explained - Embrace Changes" (ISBN-13: 978-0321278654)							
Co	ırses							
	Course nr. 18-sm-2080-pj	Course name Multimedia Communications Project Seminar II						
	InstructorTypeSWSProf. Dr. rer. nat. Björn Scheuermann, Dr. Ing. Julian Zobel, M.Sc. FridolinProject seminar3Siegmund, Prof. DrIng. Ralf SteinmetzSiegmund, Siegmund, Prof. DrIng. Ralf SteinmetzSiegmund, Siegmund, Siegmund, Siegmund, Prof. DrIng. Ralf SteinmetzSiegmund, Siegmund, Siegm							

Mo Adv	dule name	Seminar Energy Int	ormation Systems				
Mo 18-	dule nr. st-2040	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module duration	Module cy Every Seme	cle ester
Lar Ger	iguage man		I	Module owner Prof. Dr. rer. nat.	Florian Steinke		
1	1 Teaching content Students elaborate on a research-oriented subject in the area of computer-systems in a self-responsible manner. They present a written documentation and/or a presentation of the acquired advanced knowledge. They provide a set of alternative solutions to a given problem.						
2	2 Learning objectives After successful completion of the module, students will have learned to systematically develop alternative solutions to a posed problem, to critically question them and to implement goal-oriented decisions.						
3	Recommended prerequisites for participation						
4	Form of exa Module exar • Module Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	ten examination, l ion will be announ	Default RS) ced in the beginning	of the lecture	e.
5	Prerequisite Passing the f	for the award of c	redit points ation				
6	Grading Module exar • Module	n: e exam (Study achie	vement, Oral/writ	ten examination, V	Weighting: 100 %)		
7	Usability of M.Sc. etit - I	the module DT, M.Sc. ESE, M.Sc	etit - EET, M.Sc.	WI-etit, M.Sc. CE,	M.Sc. etit - CMEE		
8	Grade bonu	s compliant to §25	(2)				
9	References						
Co	Courses						
	Course nr. 18-st-2040-p	j Course name Advanced Pro	ect Seminar Energ	gy Information Sys	tems		
	Instructor Type SWS Prof. Dr. rer. nat. Florian Steinke 3						

Mo	dule name						
Aut	conomous Driv	ving Lab I					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18- Lar	su-2070	6 CP	180 h	135 n Module owner	1 Ierm	winter term	
Ger	rman			Prof. Dr. rer. nat.	Andreas Schürr		
1	 Teaching content During this module students gain practical experience in software development for embedded systems in the field of autonomous driving using a model car. In teamwork, they learn to cope with an extensive task. In order to solve this task they practice to use the theoretical knowledge available in the group (from other courses such as real-time systems, software engineering - introduction, C++ lab, digital control systems). Hands-on programming experience with C++ in the development of embedded software systems for autonomous driving based on a model car Application of control methods from the area of autonomous driving Application of software engineering techniques (design, documentation, test,) of a non-trivial embedded software system with hard real-time requirements and limited resources (memory,) Use of a given software framework and further libraries including a modular (real-time) operating system Hands-on experience using source code management systems, time management and other project management tools Presentations of the project results 						
2	 2 Learning objectives Students that have successfully participated in this module are able to organize and set-up a non-trivial software project in an interdisciplinary team according to a given problem independently. The participants acquire the following skills in detail: Independent familiarization with a given software framework and ready-made libraries Transfer of theoretic knowledge into a software system Extensive use of tools for version, configuration, and change management Realistic time and resource management (project management) Development of hardware/software systems with C++ considering important limitations of embedded systems Planning and implementation of extensive quality assurance measures Collaboration and communication in and between teams 						
3	Recommen	ded prerequisites fo	or participation				
	 ETiT/DT, iST, Informatik, WI-ET/DT: Basic software technology knowledge and advanced knowledge of object-oriented programming languages (especially C++) Additionally desired: Basic knowledge of the development of real-time systems or image processing ETiT/AUT, MEC: Basic knowledge in control engineering including state space control design, some additional basic knowledge in digital control design may be helpful 						
4	Form of exa Module exa • Modul	amination m: e exam (Study achie	vement, Oral exar	nination, Duration	: 30 Min., Default RS	5)	
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation				
6	Grading						

	Module exam: • Module exam (Study achievement, Oral examination, Weighting: 100 %)						
7	Usability of the module M Sc. MEC, M Sc. etit - DT, M Sc. WL-etit, M Sc. CF, M Sc. etit - AUT, B Sc. CF, B Sc. und M Sc. iST.						
8	Grade bonus co	Grade bonus compliant to §25 (2)					
9	References https://www.es.	tu-darmstadt.de/lehre/aktuelle-veranstaltungen/ps-af-i and M	oodle				
Co	urses						
	Course nr. 18-su-2070-pj	Course name Autonomous Driving Lab I					
	InstructorTypeSWSDr. Ing. Eric Lenz, Dr. Ing. Stefan Tomaszek, Prof. Dr. rer. nat. Andreas SchürrProject seminar3						

Mo Aut	dule name conomous Driv	ving Lab II					
Mo 18-	dule nr. su-2100	Credit points 6 CP	Workload 180 h	Self-study 135 h	Module duration 1 Term	Module cycle Summer term	
Lar	nguage	1		Module owner		1	
Ger	man/English			Prof. Dr. rer. nat.	Andreas Schürr		
1	Teaching co	ontent					
	 Further development and optimization of a robust C++ framework for solving non-trivial problems in the field of autonomous driving based on realistic challenges from the Carolo Cup, an international student competition for autonomous model cars Development and implementation of different algorithms (e.g., for motion planning, image processing, control, and obstacle avoidance) in an embedded system with hard real-time requirements and limited resources (memory,) Application and further development of control methods in the field of autonomous driving Application of software engineering techniques (design, documentation, testing,) for solving the problem Using source code management systems, time management and other project management tools Presentations of the project results 						
2	 Learning objectives Students learn to independently develop, implement and present new concepts and algorithms in the field of autonomous driving. Realistic problems from the Carolo Cup are solved with existing knowledge and skills practically and the implementation is ensured by quality assurance measures. Students who have successfully participated in this project seminar are able to independently analyze and solve a complex and realistic task in the field of autonomous driving. The participants acquire the following skills in detail: • Further development and optimization of an existing software system and the used algorithms independently • Solving and implementation of non-trivial, realistic control engineering challenges • Extensive use of tools for version, configuration, change, and quality assurance management • Realistic time planning and resource allocation (project management) • Further development and optimization of complex hardware/software systems under realistic environmen- tal conditions • Planning and implementation of extensive quality assurance measures • All he tail. 						
3	Recomment	ded prerequisites fo	or participation	nomous Driving I"	or course with simil	ar content.	
4	Form of exa Module exa • Modul	mination m: e exam (Study achie	vement, Oral exar	nination, Duration	: 30 Min., Default RS	3)	
5	Prerequisite Passing the	e for the award of c final module examina	redit points ation				
6	Grading Module exa • Modul	m: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)		
7	Usability of	the module					

	M.Sc. MEC, M.Sc. etit - DT, M.Sc. WI-etit, M.Sc. CE, B.Sc. und M.Sc. iST						
8	Grade bonus compliant to §25 (2)						
9 Co	References https://www.es.tu-darmstadt.de/lehre/aktuelle-veranstaltungen/ps-af-ii und Moodle						
	Course nr. 18-su-2100-pj	Course name Autonomous Driving Lab II					
	InstructorTypeSWSDr. Ing. Eric LenzProject seminar3						

Mo Pro	Module name Project Seminar Terahertz Technology, Communication and Sensors							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lar Ger	nguage man/English	0 Cr	240 11	Module owner Prof. Dr. rer. nat.	Sascha Preu	Every Semester		
1	 Teaching content Investigating and solving specific problems concerning the development of Terahertz devices, of applications of THz technology as well as topics of the area of Optics and communication technology. The specific task will be defined based on current research topics. The project seminar includes working on a given task by one's own, organizing and structuring of a seminar task, searching and analyzing of scientific reference publications, summarizing achieved results and conclusions by means of a written report, presenting achieved results and conclusions by means of a written report, presenting achieved results and conclusions including audience. Topics include, e.g.: Terahertz Optics Optics/photonics Spectroscopy Semiconductor devices Light-matter interaction Learning objectives Again of the seminar devices Learning objectives Again of the seminar devices Learning objectives Terahertz optices Device optices Device optice optices Device optice optices Device optice optices Device optice optice optices Device optice optice optices Device optice optice optices Device optice optice							
2	 2 Learning objectives After completion of the course, students possess: the ability to apply theoretical models to practical problems deep and special knowledge in a particular field related to THz science, optics or semiconductor physics the skills to find, analyze and evaluate scientific reference papers for a particular topic the capability to summarize the achieved scientific findings in the form of a concise report, and to present and discuss achieved results in the form of a presentation in front of an audience 							
3	Recomment Previous kno	ded prerequisites fo wledge in at least one	r participation e of the following	disciplines: Optics,	semiconductor physic	cs, or THz technology		
4	Form of exa Module exa • Modul Report and/	amination m: e exam (Study achiev for Presentation. The	vement, Oral/wri type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the project.		
5	Prerequisite Passing the	e for the award of cr	redit points					
6	Grading Module exan • Modul	m: e exam (Study achiev	vement, Oral/wri	tten examination, V	Weighting: 100 %)			
7	Usability of M.Sc. CE, M	the module I.Sc. etit - KTS, M.Sc.	iCE					
8	Grade bonu	is compliant to §25	(2)					
9	References Will be announced once the topic is defined.							
Co	urses	ľ						

Course nr. 18-pr-2030-pj	Course name Project Seminar Terahertz Technology, Communication and S	Sensors	
Instructor Prof. Dr. rer. nat.	Sascha Preu	Type Project seminar	SWS 4

Mo	dule name	mont Mothodology U	т					
Mo	dule nr	Credit points	Workload	Self-study	Module	duration	Module cv	cle
18-	sa-2010	5 CP	150 h	105 h	1 Term	durution	Winter tern	n
Lar Ger	n guage man			Module owner Prof. Ph.D. Thom	as Burg			
1	Teaching co Practical exp teamwork, v team and or	ontent periences by using m rerbal and written rep ganize the developm	nethodical proced presentation of res lent process indep	ures in the develop sults and the organ endendly.	pment of t isation of c	echnical p levelopme	roducts. In a nt. Work in a	ddition project
2	2 Learning objectives Applying the development methodology to a specific development project in a team. To do this, students can create a schedule, can analyze the state of the art, can compose a list of requirements, can abstract the task, can work out the sub-problems, can seek solutions with different methods, can work out optimal solutions using valuation methods, can set up a final concept, can derive the parameters needed by computation and modeling, can create the production documentation with all necessary documents such as bills of materials, technical drawings and circuit diagrams, can build up and investigate a laboratory prototype and can reflect their development in retrospect.							
3	Recommend Product Dev	ded prerequisites fo elopment Methodolo	or participation					
4	Form of exa Module exar • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS ced in the) beginning	of the lecture	2.
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. WI-etit, N	1.Sc. CE, M.Sc. M	edTec, B.Sc. und M	1.Sc. iST			
8	Grade bonu	s compliant to §25	(2)					
9	References Script: Deve	lopment Methodolog	gy (PEM)					
Co	urses							
	Course nr. 18-sa-2010-j	pj Product Develo	opment Methodol	ogy III				
	Instructor Prof. DrIng Kupnik, Prof	. Tran Quoc Khanh, . Ph.D. Thomas Burg	Prof. DrIng. Klau	ıs Hofmann, Prof. I	Dr. Mario	Type Project se	eminar	SWS 3

Mo	dule name	nont Mothodology II	.7					
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-	sa-2060	5 CP	150 h	105 h	1 Term		Summer ter	rm
Lar Ger	iguage man			Module owner Prof. DrIng. Tra	n Quoc Kh	anh		
1	Teaching co Practical exp teamwork, v team and or	ontent periences by using m erbal and written rep ganize the developm	nethodical proced presentation of res lent process indep	ures in the develop sults and the organ endently.	pment of t ization of o	echnical p developme	roducts. In a nt. Work in a	ddition project
2	Learning of Applying the create a sche work out the valuation me can create th and circuit d retrospect.	ojectives e development methe edule, can analyze the e sub-problems, can ethods, can set up a f ne production docun liagrams, can build u	odology to a spec e state of the art, o seek solutions wi inal concept, can nentation with all up and investigate	ific development pr can compose a list of th different metho- derive the parameto necessary docume a laboratory proto	roject in a of requiren ds, can wo ers needed ents such a type and c	team. To o nents, can a ork out opt by compu s part lists an reflect t	do this, stude abstract the ta imal solution tation and mo , technical dr their develop	nts can ask, can is using odeling, awings ment in
3	Recommended prerequisites for participation Product Development Methodology I							
4	Form of exa Module exa • Modul Report and/	mination n: e exam (Study achie or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS ced in the) beginning	of the lecture	2.
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. etit - S	the module SAE, M.Sc. CE, M.Sc.	. MedTec, B.Sc. u	nd M.Sc. iST				
8	Grade bonu	s compliant to §25	(2)					
9	References Script: Deve	lopment Methodolog	gy (PEM)					
Coi	urses							
	Course nr. 18-sa-2060-j	Course name pj Product Develo	opment Methodol	ogy IV				
	Instructor Prof. DrIng Kupnik, Prof	. Tran Quoc Khanh, . Ph.D. Thomas Burg	Prof. DrIng. Klau	ıs Hofmann, Prof. I	Dr. Mario	Type Project se	eminar	SWS 3

Mo	dule name							
Pro	ject Seminar I	lardware for Neural	Networks					
Mo	dule nr.	Credit points	Workload	Self-study	Module du	iration	Module cyc	cle
18-	zn-2020	6 CP	180 h	135 h 1 lerm Every Semester			ester	
Eng	glish			Prof. DrIng. Li Z	hang			
1	Teaching co Students wil each student improvement tion of such h search to get the results an	ntent l work on their own . In this course har of software and har ardware with comm acquainted with the re presented in a wr	in this course. To dware for neural dware methods fo lercial or open-sou hardware for neu itten report and a	pics and applicatio networks will be i r efficient hardware rce tools or FPGAs. ral networks. This i presentation.	n context w nvestigated. e for neural r Usually, the s followed by	ill be def This par networks course st y the prac	ined individu rticularly me and the imple arts with a lit ctical part and	ally for ans the ementa- cerature d finally
2	Learning objectives Successful students will know how to implement hardware for neural networks within a given application context. They can use tools to train a neural network and know how to realize it on a given hardware architecture. They are capable to evaluate the performance of an application.							
3	Recommended prerequisites for participation							
	KnowleKnowleSolid p	edge of neural netwo edge of digital or and rogramming skills (e	ork training and ir alog circuits (cf. co either in Python o	nference (cf. course ourse hardware for r VHDL depending	hardware for neural network on the appli	or neural vork) ication sc	network) cenario)	
4	Form of exa Module exan • Module	mination n: e exam (Study achie	vement, Oral exar	nination, Duration	: 30 Min., D	efault RS	3)	
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral exar	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. etit - D	the module DT, M.Sc. WI-etit, M.	.Sc. CE, M.Sc. iCE	, B.Sc. und M.Sc. i	ST			
8	Grade bonu	s compliant to §25	(2)					
9	 9 References Will be given to the students during the individual seminar kick-off meeting. 							
Cou	ırses							
	Course nr. 18-zh-2020-j	bj Course name Project Semina	ar Hardware for N	leural Networks				
	Instructor Prof. DrIng.	Li Zhang			, 	Type Project se	eminar	SWS 3

Mo Pro	dule name ject Seminar	Biophotonics					
Mo 18-	dule nr. fr-2020	Credit points 8 CP	Workload 240 h	Self-study 180 h	Module duration	Module cycle Every Semester	
Lar Ger	nguage man/English			Module owner Prof. Dr. habil. To	orsten Frosch		
1	Teaching co This module on application into practica are possible, techniques a standards.	ontent is based on practical ons of optical spectros l work with lasers, op depending on the nu and methods of data	work on current, copy and microsco otics, spectrometer umber of participa processing and s	promising and tren opy in medical techn rs, microscopes, etc. unts. The experiment tatistics and are do	d-setting topics in bio nology. Students will Participation in curr ntal results are evalu ocumented in reports	ophotonics. We focus gain a deeper insight ent research projects ated using advanced s following scientific	
2	2 Learning objectives After successful completion of this module, students will be able to analyze and evaluate biophotonic methods and techniques. In addition, they have learned to plan and implement their own projects independently and collaborate in teams. They are able to apply experimental skills and advanced techniques and methods of data analysis. Depending on the task, students learn to independently analyze, improve, or build up optical setups from scratch. In addition, it is possible to program software for controlling devices and to analyze medically relevant samples. Furthermore, the measurement results are evaluated, presented, and interpreted in a scientific context. With the gained knowledge, students are able to critically analyze existing setups or instruments and develop their own approaches. In addition, students gain experience in preparing written reports according to scientific standards. They also practice presenting their work results to a professional or lay audience.						
3	Recommended prerequisites for participation Module Basics of Optics for Biomedical Engineering						
4	Form of exa Module exa • Modul Report and/	amination m: e exam (Study achie [,] or Presentation. The	vement, Oral/writ type of examinat	tten examination, I ion will be announ	Default RS) ced in the beginning	of the lecture.	
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation				
6	Grading Module exame • Modul	m: e exam (Study achie	vement, Oral/wri	tten examination, V	Veighting: 100 %)		
7	Usability of M.Sc. CE, M	the module I.Sc. MedTec, B.Sc. u	nd M.Sc. iST				
8	Grade bonu	is compliant to §25	(2)				
9	 9 References Current scientific literature is recommended separately for the individual experiments. The following books can serve as a general reference: Kramme, Medizintechnik - Kapitel Biomedizinische Optik (Biophotonik), Springer Gerd Keiser, Biophotonics: Concepts to Applications, Springer Lorenzo Pavesi, Philippe M. Fauchet, Biophotonics, Springer Jürgen Popp, Valery V. Tuchin, Arthur Chiou, Stefan H. Heinemann, Handbook of Biophotonics, Wiley-VCH 						
CO	urses						

	Course nr. 18-fr-2020-pj	Course name Project Seminar Biophotonics		
	Instructor Prof. Dr. habil. Te	orsten Frosch	Type Project seminar	SWS 4

2.5 Field Trip

Mo Rai	Module name Railway Vehicle Engineering							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle	
Lar Ger	nguage rman	5 Gr	90 II	Module owner Prof. DrIng. Yve	s Burkhardt	Summer te		
1	Teaching co From the cor safety techno of the autom into selected solutions and depth.	ntent nprehensive and inte ology, construction er otive engineering w l chapters of the rai d procedures. Theor	erdisciplinary dom ngineering and rai ith the emphasis o l vehicle engineer retical basics as w	ain of the railway t lway operating tech of the mechanical p ring with special e ell as essential con	echnology (vehicle te nology) the module part. It offers an inter mphasis in the railw nponents of the rail v	echnology, sig picks out the rrelated intro ay-specific te vehicle are ta	nal and domain duction echnical ught in	
2	Learning ob After comple engineering	jectives ting the module, stue principles of moderr	dents will have de 1 rail vehicles.	veloped an underst	anding of the mecha	nical and mee	chanical	
3	Recommended prerequisites for participation Bachelor in Electrical Engineering, Mechatronics or Mechanical Engineering							
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisite Passing the f	e for the award of c inal module examina	redit points ation					
6	Grading Module exan • Module	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MEC,	the module M.Sc. ESE, M.Sc. eti	t - EET, M.Sc. WI	etit, B.Sc. und M.S	Sc. iST			
8	Grade bonu	s compliant to §25	(2)					
9	 References References/Textbooks: Detailed textbook; Filipovic, Z: Elektrische Bahnen. Springer, Berlin, Heidelberg, 1995. Obermayer, H.J.: Internationaler Schnellverkehr. Franckh-Kosmos, Stuttgart, 1994. 							
Cot	urses							
	Course nr. 18-bt-2050-v	l Railway Vehic	le Engineering					
	Instructor DrIng. Mich	nael Karatas			Type Lecture		SWS 2	

Mo Exc	dule name							
Mo 18-	dule nr. kn-1060	Credit points 1 CP	Workload 30 h	Self-study 30 h	Module 1 Term	duration	Module cyc Summer ter	c le rm
Lar Ger	iguage man			Module owner Prof. Dr. Mario K	upnik			
1	Teaching co During the e technology a Working field of work as th possible. Du	ntent xcursion SAE (duration and other fields will ds of an electrical engue main target. By th ring the excursion th	on 5 days) several be visited. Stude gineer can be asses ne attendance of s ne group is accomm	companies working ents can become ac ssed, with technical everal companies i modated in e.g. ho	on electri equainted - or organ n successi stels.	cal enginee with close- izational as ve days, a c	ring and infor to-reality ex- pects and cor comparison b	rmation amples. nditions ecomes
2	Learning of Upon comp production p	ojectives letion of the module processes in micro an	e, students will u id precision engin	nderstand and be eering of relevant i	able to co ndustrial o	oncisely de companies.	scribe produ	cts and
3	Recommen	ded prerequisites fo	or participation					
 Form of examination Module exam: Module exam (Study achievement, Report, p/np RS) 								
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	n: e exam (Study achie	vement, Report, V	Veighting: 100 %)				
7	Usability of B.Ed. etit, B	the module .Sc. WI-etit						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Coi	ırses							
	Course nr. 18-kn-1060-	ek Excursion SAE						
	Instructor Prof. DrIng Kupnik, Prof	. Tran Quoc Khanh, . Ph.D. Thomas Burg	Prof. DrIng. Klau	ıs Hofmann, Prof. I	Dr. Mario	Type Field trip		SWS 0

2.6 Colloquia

Mo Ind	Module name Industrial Colloquium							
Mo	dule nr.	Credit points	Workload	Self-study	Module d	luration	Module cy	cle
18-0	dt-2010	2 CP	60 h	30 h	1 Term		Summer ter	rm
Lan Ger	guage man			Module owner Prof. DrIng. Ral	f Steinmetz	Z		
1	Teaching co Primary goa be linked to students wil	ntent l of this module is to industry representa l get an impression o	o get an overview tives to improve c f different ways to	of current trends hances for an inter o give a technical p	in the ICT rnship or jo resentatior	industry. ob opportu 1.	Also, studen 1nities. Addit	ts shall tionally,
2	Learning of Students tha They can fol written repo	ojectives t have successfully fin llow a technical pres rt.	nished this module sentation and the	e know various job y can summarize t	ypes in the present	e area of co ation in th	omputer engin neir own wor	neering. ds as a
3	Recommended Mandatory: capeable to the	led prerequisites fo Basic knowledge in inderstand the techn	r participation Information Syst nical aspects and t	ems and Commub o summerize them	nication Sy in a writte	vstems. Th en report a	ne sutdent ha s a short pap	as to be er.
4	 Form of examination Module exam: Module exam (Study achievement, Report, Default RS) Report (including submission of programming code) 							
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Report, V	Veighting: 100 %)				
7	Usability of M.Sc. etit - I	the module DT, M.Sc. WI-etit, B.S	Sc. und M.Sc. iST					
8	Grade bonu	s compliant to §25	(2)					
9	References							
Coι	irses							
	Course nr. 18-dt-2010-	Course name Ko Industrial Coll	oquium					
	Instructor Prof. Dr. rer. Christian Ho Steinmetz, P	nat. Florian Steinke ochberger, Prof. Dr. rof. DrIng. Li Zhan	e, Prof. DrIng. Kl rer. nat. Andreas g	aus Hofmann, Prof Schürr, Prof. Dr	. DrIng. Ing. Ralf	Type Colloquiu	ım	SWS 2

2.7 Modules of the M.Sc. Biomedical Engineering

Please note that the modules of the Biomedical Engineering degree programs can only be selected by students of Biomedical Engineering.

Mo Clir	Module name Clinical Requirements for Medical Imaging								
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle			
18-1	mt-2020	3 CP	90 h	60 h	1 Term	Winter term			
Lan Ger	iguage man			Module owner Prof. Dr. Thomas	Vogl				
1	Teaching co The module anatomy an possible area of the respec of individual imaging diag requirement assessment	ontent deals with the requi d clinic of common of as of application of im ctive diagnostics for t procedures is dealt w gnostics in the course as or restrictions. The using common image	rements for imag clinical pictures ir aging methods for he clinical referren vith. Another persp of clinical routine participants are g e examples (some	ing methods in clin internal medicine diagnosis are discu- are explained. In pective of the modu such as structural, iven the path from of which are case-o	nical diagnostics. Base and surgery is discr ussed. In addition, the this context, the diffe le is the explanation of patient-related and p the choice of imaging priented).	sic knowledge of the ussed. On this basis, e necessity and goals rent meaningfulness of typical problems of particularly technical g diagnostics to their			
2	2 Learning objectives After successfully completing the module, the students understand the requirements for imaging methods in clinical diagnostics. They know the common indications for imaging diagnostics in the context of common clinical pictures, especially from the fields of surgery and internal medicine. Based on basic anatomical-pathophysiological knowledge, they understand the goal of the requested diagnosis. They also know about differences in imaging methods in terms of sensitivity, specificity, invasiveness, radiation exposure and cost-benefit ratio. Typical structural, technical and patient-related problems in everyday routine diagnostics are known.								
3	Recommen	ded prerequisites fo	r participation						
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	amination, Oral e	examination, Durat	ion: 60 Min., Default	t RS)			
5	Prerequisite Passing the	e for the award of c	redit points						
6	Grading Module exan • Modul	m: e exam (Technical ex	amination, Oral e	examination, Weigh	nting: 100 %)				
7	Usability of M.Sc. MedT	the module							
8	Grade bonu	is compliant to §25	(2)						
9	References Will be anno	ounced at the event							
ί Coι	irses								

	Course nr. 18-mt-2020-vl	Course name Clinical requirements for medical imaging		
	Instructor Prof. Dr. Thomas	Vogl	Type Lecture	SWS 2

Mo	dule name							
Hu: Mo	man vs. Com dule nr.	puter in Diagnostic Ir Credit points	naging Workload	Self-study	Module duration	Module cvcle		
18-	mt-2030	3 CP	90 h	60 h	1 Term	Summer term		
Lar Ger	iguage man			Module owner Prof. Dr. Thomas	Vogl			
1	 Teaching content The module deals with imaging diagnostics in routine clinical practice. For this purpose, students are taught common areas of application of imaging techniques. In addition, the goals and value for the treating doctor are explained to them. In this context, common clinical pictures are used as examples to discuss the general, case-oriented benefits, risks and costs of the respective procedures. The participants will also be given an explanation of image analysis and image diagnosis, especially with regard to the medical question. Previous and newer technical aids are discussed. This includes filters, processing tools and evaluation algorithms. In addition, frequent human and technical sources of error as well as weaknesses in imaging diagnostics are discussed. Advantages, disadvantages and limitations of computer-assisted image analysis are explained using typical everyday examples. Differences between humans and computers in image assessment such as the integration of clinical information are explained. Learning objectives The students know the areas of application of imaging methods in clinical routine. They understand the goal 							
2	2 Learning objectives The students know the areas of application of imaging methods in clinical routine. They understand the goal and the value of the requested diagnostics. They can also assess requirements for the chosen method and the limitations of this method. They are familiar with various technical aids such as image processing tools and evaluation algorithms and can continue to assess their advantages and disadvantages. They also know about the differences between human and purely computer-assisted image analysis and image assessment. Common sources of error and their causes are known. After successfully completing the module, the students can explain the advantages and limitations of human and computer-assisted image assessment and understand their differential diagnostic potential. They are familiar with the latest technical aids that have been used to date. In addition, they can assess the methodological significance of frequent medical questions.							
3	Recommen	ded prerequisites fo	or participation					
4	Form of exa Module exa • Modu As a rule, th the examina type of exam	amination m: le exam (Technical ex e examination takes t ation will be an oral y nination will be anno	kamination, Oral/ he form of a writte group examinatio bunced at the begi	written examinatio en exam (duration: n (duration: 20 mi nning of the course	n, Duration: 60 Min. 60 minutes). If up to nutes per person/pe e.	., Default RS) 20 students register, r examination). The		
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation					
6	Grading Module exa • Modu	m: le exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %)		
7	Usability of M.Sc. MedT	f the module Tec						
8	Grade bonu	is compliant to §25	(2)					
9	References Will be ann	ounced at the event						
Coi	ırses							

	Course nr. 18-mt-2030-vl	Course name Human vs. Computer in diagnostic imaging		
	Instructor Prof. Dr. Thomas	Vogl	Type Lecture	SWS 2

Mo Rac	dule name liotherapy I							
Mo	dule nr. mt-2040	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration	Module cy Winter term	cle n	
Lan Ger	iguage man	I		Module owner Dr. Jörg Licher				
1	Teaching co Basic aspect applications therapy with ionising radii therapy.	ontent s of radiation thera of ionising radiation h ionising radiation; iation in therapy; clin	py; legal framewo in therapy; system physical and tecl nical dosimetry of	ork for the use of a ns and devices for p nnical aspects of sy ionising radiation	ionising radiation in ercutaneous, intraca stems and devices f in therapy; quality as	medicine; rand int vitary and int or the applica ssurance in ra	ange of erstitial ation of adiation	
2	Learning ol The student radiation for tary and int and quality knowledge o	ojectives s receive sound basi t use in radiotherapy. erstitial therapy with assurance of radiati of the specific issues	c knowledge of th They know the fu n ionising radiatio on therapy device of radiation protec	e generation, appl nctioning of system n. They are familia es as well as the re- ction in the use of i	ication and quality a as and devices for per ar with the essential levant medical requi onising radiation in t	assurance of i cutaneous, in aspects of do rements. The cherapy.	onising itracavi- simetry ey have	
3	Recommend	ded prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	n: e exam (Technical ez	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MedT	the module						
8	Grade bonu	s compliant to §25	(2)					
9	 9 References Krieger: "Grundlagen der Strahlungsphysik und des Strahlenschutzes", 6. Auflage, Springer Spektrum, 2019 Krieger: "Strahlungsmessung und Dosimetrie", 2. Auflage, Springer Spektrum, 2013 Krieger: "Strahlungsquellen für Technik und Medizin", 3. Auflage., Springer Spektrum, 2018 Schlegel, Karger, Jäckel: "Medizinische Physik", Springer Spektrum, 2018 Wannenmacher, Wenz, Debus: "Strahlentherapie", Springer, 2013 							
Co ι	Irses	Course name						
	18-mt-2040	vl Radiotherapy	I					
	Instructor				Type Lecture		SWS 2	

Mo	dule name							
Mo	dule nr. mt-2050	Credit points	Workload 90 h	Self-study 60 h	Module of 1 Term	duration	Module cyc	cle rm
Lan Ger	iguage man			Module owner Dr. Janett Köhn				
1	Teaching co Basic aspect modalities i and inverse quality assu radiotherapy	ontent s of radiotherapy pl n therapy planning; radiation planning; a rance in radiation pl y; special features of	anning; basic me commissioning of algorithms for dos lanning; special a radiation plannin	dical and physical radiation sources e calculation: penc spects of radiation g in brachytherapy	principles in tele- and il beam, co planning i	of therapy d brachyth ollapsed co in stereota	y planning; in herapy; conve ne and Monte hetic or radios	maging entional e Carlo; surgical
2	Learning of The students therapy with familiar wit assurance in	ojectives s receive sound basic n ionising radiation; t h different planning n radiation planning.	knowledge in radi hey know the basi procedures and al	ation planning for p c medical and physi gorithms. They are	percutaneo ical princip e familiar v	us, intraca les of thera with the pr	vitary and int apy planning rocedures for	erstitial and are quality
3	Recommen	ded prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisit Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MedT	the module						
8	Grade bonu	is compliant to §25	(2)					
9 Со1	9 References Krieger: "Grundlagen der Strahlungsphysik und des Strahlenschutzes", 6. Auflage, Springer Spektrum, 2019 Krieger: "Strahlungsmessung und Dosimetrie", 2. Auflage, Springer Spektrum, 2013 Krieger: "Strahlungsquellen für Technik und Medizin", 3. Auflage., Springer Spektrum, 2018 Schlegel, Karger, Jäckel: "Medizinische Physik", Springer Spektrum, 2018 Wannenmacher, Wenz, Debus: "Strahlentherapie", Springer, 2013 Course nr. Course nr.							
	18-mt-2050-vl Radiotherapy II Instructor Type SWS Dr. Janett Köhn Lecture 2							

Mo Nuc	dule name clear Medicine							
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cyc	cle
18-	IIII-2000	3 CP	90 h	00 11	1 Ierm		winter tern	<u>n</u>
Lar Ger	iguage man			Module owner	opel			
1	Basic principles of nuclear medical diagnostics and therapy (radiopharmaceuticals); biological radiation effects and toxicity of radioactively labelled substances; biokinetics of radioactively labelled substances, determination of organ doses; radiation measurement technology and dosimetry in nuclear medicine; imaging: Planar gamma camera systems, emission tomography with gamma rays (SPECT), positron emission tomography (PET); data acquisition and processing in nuclear medicine; in vivo examination methods; in vitro diagnostics; nuclear medicine therapy and intratherapeutic dose measurement; quality control and quality assurance; radiation protection of patients and staff; planning and setting up nuclear medicine departments							
2	Learning obj The students to of different ra know the diff the specific is	ectives ecceive sound basic l adiopharmaceutica erent systems and p sues of radiation pr	knowledge of nucle ls and are familia procedures of nucle rotection in the us	ear medicine. They l r with the dosimetr ear medical diagnos e of ionising radiat	know the pl ric procedu stics and th ion in nucl	hysical and ires in nuc erapy. The ear medici	biological pro lear medicino y have knowl ne.	operties e. They ledge of
3	Recommend	ed prerequisites fo	or participation					
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 							
5	Prerequisite Passing the fi	for the award of c nal module examin	redit points ation					
6	Grading Module exam • Module	: exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of t M.Sc. MedTe	he module						
8	Grade bonus	compliant to §25	(2)					
9	 References Krieger: "Grundlagen der Strahlungsphysik und des Strahlenschutzes", 6. Auflage, Springer Spektrum, 2019 Krieger: "Strahlungsmessung und Dosimetrie", 2. Auflage, Springer Spektrum, 2013 Krieger: "Strahlungsquellen für Technik und Medizin", 3. Auflage., Springer Spektrum, 2018 Schlegel, Karger, Jäckel: "Medizinische Physik", Springer Spektrum, 2018 Grünwald, Haberkorn, Kraus, Kuwert; "Nuklearmedizin". 4. Auflage. Thieme. 2007 							
Cou	ırses							
	Course nr. 18-mt-2060-v	Course name Nuclear Medic	rine					
	InstructorTypeSWSDr. Christian HappelLecture2							

Ma	4								
Dig	ital Dentistry	and Surgical Robotic	cs and Navigation	I					
Mo	dule nr.	Credit points	Workload	Self-study	Module o	duration	Module cy	cle	
18-	mt-2070	3 CP	90 h	60 h	1 Term		Winter tern	<u>n</u>	
Ger	iguage man			Prof. Dr. Dr. Robert Sader					
1	Teaching co The module planning ca transferred t data acquisi magnetic res procedures systems. On and reconstr dentistry suc	ontent deals with the basic n be carried out in to the intraoperative tion (intra- and extra sonance imaging, con by intraoperative pass e focus is the applica uctive surgery, oncolo ch as dental implante	s methods and de the speciality are situation to suppo oral scanning syst ne-beam compute ssive (navigation, tion in the areas o ogic surgery, espect ology, jaw reconsti	vices with which p as of surgery and ort the practitioner. ems, radiological p d tomography) and augmented reality f neuronavigation, ially in the field of u cuctions or care with	reoperative digital der The proce procedures l the variou) and active spine and prology, and th individu	e three-dir ntistry, and dures rang such as co us software e (robotics pelvic surg d various an al denture	nensional tre l which also ge from preop mputed tomo e-based 3D-pl s, Telemanipu gery in traum reas of recons s.	atment can be perative ography, lanning lation) a, hand tructive	
2	 Learning objectives After successfully completing the module, the students have first insights into the principles, strategies and concepts of medical and dental robotics and navigation as well as the functionality of the associated software and devices. They will be able to describe the workflow from data acquisition to intraoperative implementation. They know the basic advantages and limitations of the various procedures in different medical and dental applications and can independently apply this knowledge to interdisciplinary issues in surgery and digital dentistry together with engineering and thus formulate basic specialist positions. Becommended prerequisites for participation 								
3	Recomment	ded prerequisites it	n participation						
4	Form of exa Module exa • Modul	mination n: e exam (Technical e:	xamination, Exam	ination, Duration:	60 Min., D	efault RS)			
5	Prerequisite Passing the	e for the award of c	redit points ation						
6	Grading Module exan • Modul	n: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)				
7	Usability of M.Sc. MedT	the module ec							
8	Grade bonu	s compliant to §25	(2)						
9 Cot	References To be publis	hed during the even	t.						
	Course nr. 18-mt-2070-	Course name Vl Digital Dentist	try and Surgical R	obotics and Naviga	tion I				
	Instructor Prof. Dr. Dr.	Robert Sader		0		Type Lecture		SWS 2	
Mo	Module name Digital Dentistry and Surgical Robotics and Navigation II								
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Mo	dule nr.	Credit points	Workload	Self-study	Module o	luration	Module cyc	cle	
Lar Ger	nguage man	3 CP	90 h	Module owner Prof. Dr. Dr. Robert Sader					
1	Teaching co The module and devices dentistry can These medio narrow cont and pelvic su and various individual d	ontent deepens the learnin with which preopera h be carried out and cal technology proce ext of their medical a urgery in trauma, han areas of reconstruction	g content present ative three-dimens can also transferra esses, concepts an applications. One fe d and reconstructi ive dentistry such	red in Lecture I and ional treatment pla ed to the intraoper d associated devic ocus is the applicati ve surgery, oncolog as dental implanto	l compreh anning in t ative situat e technolo on in the a ic surgery, o blogy, jaw 1	ensively pa he fields o tion to sup gies are no reas of neu especially i reconstruct	resents the m f surgery and port the prac ow presented uronavigation in the field of tion or the su	nethods l digital titioner. l in the l, spinal urology, upply of	
2	2 Learning objectives After successfully completing the module, students have comprehensive insights into the current principles, strategies and concepts of medical and dental robotics and navigation as well as the functionality of the associated software and devices. They are able to describe the workflow from data acquisition to intraoperative implementation and to understand the functionalities of the disciplines involved in their interdisciplinary networking as well as the related interface problems. They know the advantages and limitations of the various procedures in different medical and dental applications. In addition, they can independently apply the knowledge they have acquired to interdisciplinary issues in surgery and digital dentistry together with engineering and thus formulate subject-related positions.								
3	Recommen Digital Dent	ded prerequisites fo istry and Surgical Ro	or participation botics and Naviga	ition I					
4	Form of exa Module exa • Modul	mination n: e exam (Technical ex	xamination, Exam	ination, Duration:	60 Min., D	efault RS)			
5	Prerequisite Passing the	e for the award of c	redit points ation						
6	Grading Module exan • Modul	n: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)				
7	Usability of M.Sc. MedT	the module ec							
8	Grade bonu	s compliant to §25	(2)						
9	9 References To be published during the event								
Coι	urses								
	Course nr.Course name18-mt-2080-vlDigital Dentistry and Surgical Robotics and Navigation II								
	Instructor Prof. Dr. Dr.	Robert Sader				Type Lecture		SWS 2	

Module name									
Dig	ital Dentistry	and Surgical Robotic	es and Navigation	III					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle			
18-	mt-2090	3 CP	90 h	60 h	1 Term	Winter term			
Ger	rman			Module owner Prof. Dr. Dr. Robert Sader					
1	 Teaching content The module deepens the learning content presented in Lecture I and presents the latest and visionary methods and devices with which preoperative three-dimensional treatment planning in the fields of surgery and digital dentistry can be carried out and transferred to the intraoperative situation to support the practitioner. These medical technology processes, concepts and associated device technologies are presented problem-oriented and in the narrow context of their medical applications. Based on existing technology problems, future developments in medical technology are presented and discussed. One focus is the application in the areas of neuronavigation, spinal and pelvic surgery in trauma, hand and reconstructive surgery, oncology, especially in the field of urology and various areas of reconstructive dentistry such as dental implantology, jaw reconstruction or care with individual dentures. 								
2	2 Learning objectives After successfully completing the module, students have comprehensive insights into the procedures and devices used in surgical and dental 3D planning, the manufacture of patient-specific implants and dentures, as well as robotics and navigation. You are able to describe the functionalities of the systems involved on the basis of the workflow from data acquisition to intraoperative application-related. One focus is the necessary interdisciplinary networking and the associated interface problems. The students know the advantages and limitations of different procedures in different medical and dental applications. In addition, they can independently develop the knowledge they have acquired and generate new interdisciplinary issues in surgery and digital dentistry combined with optimacring.								
3	Recommen Concomitan the module	ded prerequisites fo t participation either " Digital Dentistry an	or participation in the module "Di nd Surgical Roboti	gital Dentistry and cs and Navigation 1	Surgical Robotics an II" is recommended.	nd Navigation I" or in			
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	60 Min., Default RS)				
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation						
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)				
7	Usability of M.Sc. MedT	the module Tec							
8	Grade bonu	is compliant to §25	(2)						
9	9 References To be published during the event.								
Coi	Courses								

Course nr. 18-mt-2090-vl	Course name Digital Dentistry and Surgical Robotics and Navigation III		
Instructor Prof. Dr. Dr. Robe	ert Sader	Type Lecture	SWS 2

Mo	Module name								
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle		
18-	mt-2100	3 CP	90 h	60 h	1 Term	Winter tern	n		
Lar Ger	iguage rman			Module owner Prof. Dr. Dr. Kai Zacharowski					
1	Teaching co Within the s System, Hea are presente are presente results.	ontent cope of the module, l art, Kidney, Coagulati ed. Based on this, cu ed. Emphasis is place	pasic physiology an ion and Gastrointe rrent technologie rd on understandin	nd anatomy from the estinal Tract. Furthe s for monitoring and ng and interpreting	ne areas of: Lung, New ermore, selected path ad surveillance of div g "normal" and patho	rves, Central I nologies and c verse body fu logical measu	Nervous liseases .nctions ırement		
2	2 Learning objectives After completing the module, the students have basic knowledge of anatomy and physiology with corresponding reference to disease patterns and their pathophysiology. Through this knowledge, the students are able to assess physiological and pathophysiological measurement results of various devices in context and to understand their indication.								
3	Recommended prerequisites for participation								
4	 Form of examination Module exam: Module exam (Technical examination, Examination, Duration: 60 Min., Default RS) 								
5	Prerequisite Passing the	e for the award of c	redit points ation						
6	Grading Module exan • Modul	m: e exam (Technical e:	xamination, Exam	ination, Weighting	: 100 %)				
7	Usability of M.Sc. MedT	the module ec							
8	Grade bonu	is compliant to §25	(2)						
9	9 References								
Cot	Courses								
	Course nr. Course name 18-mt-2100-vl Anesthesia I								
	InstructorTypeSWSProf. Dr. Timo Stöver, Prof. Dr. Dr. Kai ZacharowskiLecture2								

Mo Clir	Module name Clinical Aspects ENT & Anesthesia II							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lar Ger	nguage rman		70 11	Module owner Prof. Dr. Dr. Kai Z	Zacharowski	Summer term		
1	 Teaching content ENT: Consolidation of knowledge in the anatomy, physiology and pathophysiology of the ear. In addition, basic knowledge of phoniatrics is imparted and here the anatomy and function of the larynx and the swallowing apparatus as well as basic aspects of phoniatric diagnostics and therapy are explained. The anatomy and function of the nasal head and sinuses are presented together with the associated diagnostic procedures. In the subject area of neurootology, knowledge of the function of the vestibular apparatus is deepened and associated diagnostic procedures are explained. In the field of surgical assistance in ENT, procedures of computer-assisted navigation, applications of robotics, neuromonitoring and procedures of laser surgery are presented. Anesthesia II: During the module, basic physiology and anatomy from the areas of: Lung, Nervous, Central Nervous System, Heart, Kidney, Coagulation and Gastrointestinal Tract. Furthermore, selected pathologies and diseases are presented. Emphasis is placed on understanding and interpreting "normal" and pathological measurement results. Learning objectives 							
2	2 Learning objectives The students have acquired basic knowledge of the anatomy, physiology and pathophysiology of the inner ear, nose, larynx and swallowing apparatus in the field of ENT. They know basic diagnostic examination procedures of ENT/phoniatrics. Furthermore, the students have acquired knowledge about the structure and function as well as the application of intraoperative assistance systems in ENT. In the field of anesthesia, the students have acquired basic knowledge in anatomy and physiology with corresponding reference to clinical pictures and their pathophysiology. Through this knowledge, students are able to understand the indication of the use of physiological and pathophysiological diagnostic procedures and can assess measurement results of the discussed diagnostic devices in context.							
3	Recommen "Anesthesia	ded prerequisites fo I"	or participation					
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	60 Min., Default RS)			
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation					
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of M.Sc. MedT	f the module Tec						
8	Grade bonı	is compliant to §25	(2)					
9 Coi	References Boenningha urses	us, HG., Lenarz, T.	(2012) Otorhinola	aryngology. Spring	er.			

Course nr. 18-mt-2110-vl	Course name Clinical Aspects ENT & Anesthesia II		
Instructor Prof. Dr. Dr. Kai Z	Zacharowski	Type Lecture	SWS 2

Mo Auc	Module name Audiology, Hearing Aids and Hearing Implants								
Mo	dule nr. mt-2120	Credit points	Workload	Self-study	Module duration	Module cycle			
Lar	nguage	5.01	70 H	Module owner Prof. Dr. Timo Sto	över	whiter term			
1	 Teaching content Students learn basic concepts of audiology and gain knowledge of objective and subjective methods for the diagnosis of hearing disorders. In addition, the various devices used in diagnostics are explained and corresponding standards and guidelines are discussed. In the field of pediatric audiology, procedures and devices for performing newborn hearing screening are presented. The design, function and fitting of conventional technical hearing aids and implantable systems are presented. In addition to signal processing and coding strategies of cochlear implant systems, special features of electric-acoustic stimulation are discussed. Special emphasis is given to the treatment of the specific aspects of electrical stimulation of the auditory sense. Students will learn about the fitting pathway for hearing implants, diagnostic procedures for indication, and strategies for managing adverse events. The fitting and monitoring of cochlear implant systems as well as active hearing implants will be explained. The concepts of rehabilitation and support options for hearing impaired children and adults will be presented. Learning objectives 								
2	2 Learning objectives After successful completion of the module, students will be familiar with the procedures of subjective and objective audiology and will have learned how the equipment required for the examinations works. They know the advantages and limitations of the various diagnostic procedures in different applications. They have learned the construction, functioning and fitting of conventional technical hearing aids as well as implantable hearing systems. They are able to describe the care process with the various hearing systems and to understand the functionalities of the disciplines involved in their interdisciplinary networking as well as the interface problems. They know the advantages and limitations of the different hearing systems and can name the most important criteria for indication. In addition, they can independently apply their acquired knowledge to interdisciplinary issues of audiology together with the engineering sciences and thus formulate subject-related positions.								
3	Recomment	ded prerequisites fo	or participation						
4	Form of exa Module exam • Modul The examina 7 students re will be anno	mination m: e exam (Technical ex ation takes place in fo egister, the examinat unced in the beginni	kamination, Oral/ orm of a written ex ion will be an ora ing of the lecture.	written examinatio am (duration: 60 n l examination (dur	n, Duration: 60 Min. ninutes). If one can es ation: 30 min.). The	., Default RS) stimate that less than type of examination			
5	Prerequisite Passing the	e for the award of c	redit points ation						
6	Grading Module exan • Modul	m: e exam (Technical ex	kamination, Oral/	written examinatio	n, Weighting: 100 %))			
7	Usability of M.Sc. MedT	the module							
8	Grade bonu	is compliant to §25	(2)						
9 Cot	References Kießling J, K urses	Collmeier B, Bauman	n U. Care with hea	aring aids and hear	ing implants. 3rd ed	. Thieme; 2017			

Course nr. 18-mt-2120-vl	Course name Audiology, hearing aids and hearing implants		
Instructor Prof. Dr. Timo St	över	Type Lecture	SWS 2

Mo Bas	Module name Basics of Medical Information Management							
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cyc	cle	
18-	mt-2130	3 CP	90 h	60 h	1 Term	Winter tern	n	
Lar Ger	nguage man/English			Module owner Prof. Dr. Holger Storf				
1	 1 Teaching content This lecture aims to provide insights into the medical information management focusing on the clinical context. Basic concepts of hospital information systems (HIS) Exchange formats in clinical information systems (HL7, HL7-FHIR, DICOM) Medical data models Interfaces with clinical research Basic concepts of medical documentation Telemedicine / assistive health technology 							
2	Learning of After success landscape an	bjectives If ul completion of the Ind understand formation	e course, students and concepts of	are familiar with th f interfaces for info	e terminology of a ty prmation exchange.	pical hospital	system	
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Study achievement, Oral/written examination, p/np RS) The type of examination will be announced in the first lecture. Possible types include presentation (30 minutes), 							
5	Prerequisite Passing the	e for the award of c final module examin	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	vement, Oral/writ	tten examination, V	Neighting: 100 %)			
7	Usability of M.Sc. MedT	the module ec						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	urses							
	Course nr. 18-mt-2130-	vl Basics of medi	cal information m	anagement				
	Instructor			0	Type Lecture		SWS 2	

Mo Tec	dule name hnical Perforr	nance Optimization	of Radiological Di	agnostics				
Mo 18-	dule nr. mt-2140	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module o 1 Term	luration	Module cyo Winter tern	c le n
Lar Ger	i guage man		I	Module owner Prof. Dr. Thomas Vogl				
1	1 Teaching content In this module, students learn ways to optimize the performance of radiological diagnostics. Common areas of application of projection radiography, computed tomography (CT), magnetic resonance imaging (MRI) and angiography are taught. Limitations of the procedures used in relation to common medical questions are explained. In addition, current research results and research projects in the field of radiological diagnostics are presented and explained to the students. On this basis, a research-oriented module approach with a focus on the technical optimization of a radiological procedure in a typical clinical application will be pursued.							
2	2 Learning objectives After successfully completing the module, the students are familiar with current scientific questions regarding the technical development of radiological-diagnostic procedures. They know common areas of application of radiological procedures in clinical routine and understand their meaningfulness and value. They also know about common problems and limitations of common procedures and can discuss them on a scientific level. They are also able to develop and pursue their own current research hypotheses in the field of technical support for radiological procedures. Another aim of this module is that students discuss scientific questions with clinicians working in radiology and learn the dialog between developers, researchers and users. Finally, the results are presented in a simulated scientific lecture and then discussed.							
3	Recommend	led prerequisites fo	or participation					
4	Form of exa Module exar • Modul The examina min), report	mination n: e exam (Study achie ation form will be an	vement, Oral/writhnounced at the b	tten examination, I eginning of the co	Default RS) urse. Possi) ble paths a	are presentat	ion (25
5	Prerequisite Passing the f	e for the award of c inal module examin	redit points ation					
6	Grading Module exar • Modul	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MedTe	the module ec						
8	8 Grade bonus compliant to §25 (2)							
9 Coi	9 References Will be announced at the event							
	Course nr.Course name18-mt-2140-pjTechnical performance optimization of radiological diagnostics							
	Instructor Prof. Dr. The	omas Vogl				Type Project se	eminar	SWS 4

Mo Sen	dule name ninar Radiatio	on Physics and Techr	ology in Medicine	2				
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
18-1	mt-2150	3 CP	90 h	60 h	1 Term		Winter tern	a
Lan Ger	iguage man			Module owner Dr. Jörg Licher				
1	Teaching co	ontent						
	 Independent study of current specialist literature, conference and journal papers from the field of radio-therapy and nuclear medicine on a selected topic in the area of basic methods. Critical examination of the topic dealt with Own further literature research Preparation of a lecture (written paper and slide presentation) on the topic dealt with Presentation of the lecture to an audience with heterogeneous prior knowledge Professional discussion of the topic after the lecture 							
2	Learning objectives The students independently acquire in-depth knowledge of aspects of modern radiotherapy or nuclear medicine based on current scientific articles, standards and reference books. In doing so, they learn how to search for and evaluate relevant scientific literature. You can analyse and assess complex physical, technical and scientific information and present it in the form of a summary. The acquired knowledge can be presented in front of a heterogeneous audience and a professional discussion can be held on the acquired knowledge.							
3	Recomment Radiotherap	ded prerequisites fo y I; Nuclear Medicin	or participation e					
4	Form of exa Module exa • Modul	mination n: e exam (Study achie	evement, Oral exam	nination, Duration	: 30 Min.,	Default RS	5)	
5	Prerequisite Passing the f	e for the award of c	redit points ation					
6	Grading Module exan • Modul	n: e exam (Study achie	evement, Oral exam	nination, Weightin	g: 100 %)			
7	Usability of M.Sc. MedT	the module						
8	Grade bonu	s compliant to §25	(2)					
9	9 References Will be announced at the beginning of the course.							
Coι	ırses							
	Course nr.Course name18-mt-2150-seSeminar Radiation Physics and Technology in Medicine							
	Instructor Dr. Jörg Lich	ıer				Type Seminar		SWS 2

Mo Inte	dule name ernship in Su	rgery and Dentistry I						
Mo 18-	dule nr. mt-2160	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration	Module cycle Winter term		
Lar Ger	iguage rman			Module owner Prof. Dr. Dr. Robe	ert Sader			
1	Teaching co The module especially in oncologic su implantolog associated s and can also	ontent includes the clinical a the areas of neurona argery, especially in the y, jaw reconstruction oftware applications o carry out initial prac	applications of sur- avigation, spinal and ne field of urology or the provision o and technologies tical exercises. In	gical robotics and n nd pelvic surgery in ; and various areas f individual dentur of the associated n selected cases, the c	avigation and digital a trauma, hand and re of reconstructive der es. The students are nedical device techno clinical use is demons	dentistry procedures, econstructive surgery, ntistry such as dental familiarized with the ologies in their basics trated on the patient.		
2	2 Learning objectives After successfully completing the module, the students have first insights into the principles and functions of radiological and non-radiological scanning procedures for generating 3D-patient treatment data, their software- based evaluation, their further use for treatment planning and the technological transfer to the actual treatment situation. They can name the clinical fields of application in surgery and dentistry and the advantages and disadvantages, especially in the areas of neuronavigation, spinal and pelvic surgery, urological oncology, dental implantology and various areas of reconstructive digital dentistry and oral and cranio-maxillofacial surgery. In addition, they can position their acquired knowledge in the context of other interdisciplinary issues in medicine and engineering and thus formulate fundamental subject-related positions.							
3	Recommended prerequisites for participation Concomitant participation in the module "Digital Dentistry and Surgical Robotics and Navigation I" is recom- mended.							
4	 Form of examination Module exam: Module exam (Technical examination, Colloquium, Duration: 20 Min., p/np RS) The colloquium takes place during the internship in the context of scientific discussions on the contents of the weekly units. The module is considered to have been passed if the student has attended a time portion of usually 80% of the course offerings and has participated in the scientific discusse on the contents of the weekly units. The qualification goals of the module, e.g. clinical application of various procedures, familiarization with medical device technologies, the performance of practical exercises and clinical demonstration on patients, can only be							
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation					
6	Grading Module exa • Modu	m: le exam (Technical ex	xamination, Collo	quium, Weighting:	100 %)			
7	Usability of M.Sc. MedT	f the module Tec						
8	Grade bonu	is compliant to §25	(2)					
9	References To be publis	shed during the event	ī.					
Coi	urses							

Course nr. 18-mt-2160-pr	Course name Internship in Surgery and Dentistry I		
Instructor Prof. Dr. Dr. Robe	ert Sader	Type Lab	SWS 2

Mo Inte	dule name	gery and Dentistry II	r					
Mo	dule nr. mt-2170	Credit points	Workload 90 h	Self-study 60 h	Module duration	Module cycle		
Lan Ger	iguage man			Module owner Prof. Dr. Dr. Robe	ert Sader			
1	The module includes the deepend clinical application of procedures in surgical robotics and navigation and digital dentistry, especially in the areas of neuronavigation, spine and pelvic surgery in trauma, hand and reconstructive surgery, in oncologic surgery, especially in the field of urology, and in various areas of reconstructive dentistry such as dental implantology, jaw reconstructions or the supply of individual dentures. The students are made familiar with the associated software applications and technologies of the associated medical device technologies in clinical use and they also carry out practical exercises. In selected cases, clinical use is demonstrated on the patient.							
2	Learning objectives After successfully completing the module, the students have comprehensive insights into the principles and functions of radiological and non-radiological scanning methods for generating 3D-patient treatment data, their evaluation, their further use for 3D-treatment planning and the technological transfer to the actual treatment situation. They can name the clinical fields of application in surgery and dentistry and can comprehensively describe the advantages and disadvantages of the different applications for the respective application, especially in the areas of neuronavigation, spinal and pelvic surgery, urological oncology, dental implantology and various areas reconstructive digital dentistry and oral and cranio-maxillofacial surgery. In addition, they can independently apply the knowledge they have acquired to other interdisciplinary issues in medicine and engineering and thus formulate subject-related positions.							
3	Recomment Concomitan mended.	ded prerequisites fo t participation in the	or participation e module "Digital 1	Dentistry and Surg	ical Robotics and Na	vigation II" is recom-		
4	Form of exa Module exa • Modul	mination m: e exam (Technical ex	xamination, Colloo	quium, Duration: 2	0 Min., p/np RS)			
5	Prerequisite Passing the passing the passi	e for the award of cr module is passed if the final offered. The qualifica on with medical devic can only be achieved : Attendance regulati	redit points I module examina ation objectives of the technologies, the I through regular ion according to th	tion has been pass f the module, e.g. of performance of pra participation in the ne framework regul	ed and the student l clinical application of actical exercises and c e practical course. lations of Goethe Uni	nas attended 80% of f various procedures, linical demonstration versity Frankfurt am		
6	Grading Module exam: • Module exam (Technical examination, Colloquium, Weighting: 100 %)							
7	Usability of M.Sc. MedT	t he module ec						
8	Grade bonu	is compliant to §25	(2)					
9	References To be publis	hed during the event						

Co	urses			
	Course nr. 18-mt-2170-pr	Course name Internship in Surgery and Dentistry II		
	Instructor Prof. Dr. Dr. Rob	ert Sader	Type Lab	SWS 2

Mo	dule name							
Inte	ernship in Sur	gery and Dentistry II		0.10.11	Dr. 1.1. Junetter	N. J. J 1.		
18-	dule nr. mt-2180	3 CP	workload 90 h	60 h	1 Term	Winter term		
Lar	iguage	1		Module owner		1		
Ger	man			Prof. Dr. Dr. Robe	ert Sader			
1	The module includes the comprehensive clinical application of procedures in surgical robotics and navigation and digital dentistry, especially in the areas of neuronavigation, spine and pelvic surgery in the field of trauma, hand and reconstructive surgery, and oncology, especially in the field of urology and various areas of reconstructive dentistry such as dental implantology, jaw reconstructions or the dental care with individual dentures. The students will be familiar with the associated software applications and technologies of the associated medical device technologies that they can independently develop further questions to be solved in the context of a master's or doctoral thesis. For this, they also carry out practical exercises in which different medical products are involved. In selected cases, the clinical use is demonstrated on the patient.							
2	2 Learning objectives After successfully completing the module, the students have comprehensive insights into the principles and functions of radiological and non-radiological scanning methods for generating 3D-patient treatment data, their software-based evaluation, their further use for treatment planning and the technological transfer to the actual treatment situation. They know the current clinical fields of application in surgery and dentistry, can describe the advantages and disadvantages of the different applications and can develop problem-solving approaches. This is implemented in particular in the areas of neuronavigation, spine and pelvic surgery, urological oncology, dental implantology and various areas of reconstructive digital dentistry and oral and cranio-maxillofacial surgery. They can independently apply the knowledge they have acquired to other interdisciplinary issues in medicine and engineering and thus can formulate subject-related positions and can develop solutions.							
3	Recommende Concomitan mended.	ded prerequisites fo t participation in the	r participation module "Digital I	Dentistry and Surgi	cal Robotics and Nav	vigation III" is recom-		
4	Form of exa Module exa • Modul The colloqui weekly units The module the course of qualification device techn achieved thr	amination m: e exam (Technical ex ium takes place during, is considered to hav offerings and has par a goals of the module pologies, the performa- rough regular particip	camination, Collog ng the internship we been passed if ticipated in the so e, e.g. clinical app ance of practical e pation in the inter	quium, Duration: 2 in the context of sc the student has at cientific discourse lication of various exercises and clinic nship.	0 Min., p/np RS) ientific discussions of tended a time portic on the contents of th procedures, familiar al demonstration on p	n the contents of the on of usually 80% of he weekly units. The ization with medical patients, can only be		
5	Prerequisite Passing the f	e for the award of cr final module examina	redit points ation					
6	Grading Module exan • Modul	n: e exam (Technical ex	amination, Colloo	quium, Weighting:	100 %)			
7	Usability of M.Sc. MedT	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							

	To be published during the event.						
Co	Courses						
	Course nr. 18-mt-2180-pr	Course name Internship in Surgery and Dentistry III					
	Instructor Prof. Dr. Dr. Robe	ert Sader		Type Lab	SWS 2		

Mo Inte	dule name ernship "Med	icine Live"					
Mo	dule nr. mt-2190	Credit points	Workload 90 h	Self-study 60 h	Module duration	Module cycle Winter term	
Lar Ger	nguage man			Module owner Prof. Dr. Dr. Kai Z	Zacharowski		
1	 Teaching content As part of the combined POL seminar / simulation training, students are given the opportunity to work together under supervision on everyday problems in the context of patient care. Problems are evaluated and solution strategies are developed. Anesthesia: In simulation training, students can practice the procedure of a classic anesthesia on mannequins and deepen previously learned knowledge from lectures and practical courses on airway management and airway devices. Through guided hands-on training, a close link to practice is established and understanding is further deepened. ENT: Students receive practical insights into procedures of audiological, neurootological and phoniatric diagnostics and are familiarized with the respective device technology. Furthermore, procedures for metrological control of conventional hearing aids are demonstrated and practical exercises are performed. In addition, basic aspects of electrical stimulation of the auditory nerve are clarified by means of practical exercises with cochlear implant systems.						
2	Learning o After compl in context. and ENT/pl practiced. T of medical t	bjectives eting the module, students The students receive noniatrics. In the prace this provides a better us echnology equipmen	dents are able to v an overview of the tical part, manual understanding of r t in later professio	vork out and solve p e equipment techno skills are trained a nedical activities, w nal life.	problems and simple plogy used in the spe nd the use of various hich facilitates comn	issues independently cialties of anesthesia diagnostic devices is nunication with users	
3	Recomment Competence	ded prerequisites for ies from the "Anesthe	or participation sia I & II" modules	5.			
4	Form of ex Module exa • Modu The oral exa per content	amination m: le exam (Study achie amination takes the fo area (anesthesia and	vement, Presentat orm of a presentati ENT).	ion, Duration: 20 I on during the inter	Min., p/np RS) nship. As a rule, ther	e is one presentation	
5	Prerequisit Passing the	e for the award of c	redit points ation				
6	 6 Grading Module exam: • Module exam (Study achievement, Presentation, Weighting: 100 %) 						
7	Usability of M.Sc. Med	f the module					
8	Grade bon	us compliant to §25	(2)				
9	References						
Coi	Courses						

Course nr. 18-mt-2190-pr	Course name Internship "Medicine Live"		
Instructor Prof. Dr. Timo St	över, Prof. Dr. Dr. Kai Zacharowski	Type Lab	SWS 2

Mo Intr	dule name roduction to F	Ethics: The Example of	of Medical Ethics					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle		
Lar Ger	nguage man	0.01		Module owner Prof. Dr. Christof	Mandry			
1	1 Teaching content In exploring basic questions of medical ethics, the lecture provides an introduction to ethical thinking and the theories and reasoning of ethics. At the same time, it imparts basic knowledge about central and selected current discussions in medical ethics and healthcare ethics. Different Levels will be dealt with: What are the sets od values comprised in our notions of health and illness? What are the necessary requirements for decisions to be ethically good and correct? How are courses of action at the beginning and at the end of life to be evaluated? Is health to be regarded as an "asset" that can be "distributed" through public systems, and what criteria of justice do healthcare systems have to meet?							
2	2 Learning objectives Students know basic terms of ethics, like norm, responsibility, duty, ought, and (human) rights, as well as central classifications of ethics into metaethics, ought ethics, aspiration ethics, and domain ethics. They are familiar with different approaches to ethics and the justification of norms (deontological / teleological, virtue ethical approaches) and their respective theoretical prerequisites as well as strengths and weaknesses. Also, they are familiar with medical ethics being specific ethics with typical approaches like the Beauchamp/Childress principles model. Students have a basic understanding of fundamental conflicts in medical ethical decision making, for example regarding treatment at the beginning and the end of life and are able to analyze exemplary cases in a structured manner and make well-founded assessments. They know central legal regulations of selected clinical contexts (such as living wills or organ donation) and are familiar with the corresponding ethical discussions. They are familiar with basic social-ethical approaches like Rawls' theory of justice and understand their relevance to head their relevance.							
3	Recommen	ded prerequisites fo	or participation					
4	Form of exa Module exa • Modu Module exa The examin registration	amination m: le exam (Study achie Im usually is a writte ation method will be period (during terms	vement, Oral/wri en exam (duration announced at the s where no course	tten examination, I n: 60 minutes) or a e start of the lectur s are offered).	Duration: 60 Min., Do an oral exam (durati e, or one week after	efault RS) ion: 15-20 minutes). the end of the exam		
5	Prerequisit Passing the	e for the award of c	redit points ation					
6	 6 Grading Module exam: • Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 							
7	Usability of M.Sc. MedT	f the module Tec						
8	Grade bonu	is compliant to §25	(2)					
9	References							
Co	Courses							

Course nr. 18-mt-2200-vl	Course name Introduction to Ethics: The Example of Medical Ethics		
Instructor Prof. Dr. Christof	Mandry	Type Lecture	SWS 2

3.4.	dula n							
Cur	rent Issues in	Medical Ethics						
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
Lan	iguage	5.61	70 11	Module owner	1 Ieiiii		winter term	
Ger	German Prof. Dr. Christof Mandry							
1	1 Teaching content This course deals in depth with current issues in medical ethics. These can either de related to clinical ethics (ethical decisions in medicine), such as organ removal and organ transplantation, change of therapeutic objectives, terminal care, etc. Or the issues are related to research ethics (for example research on individuals without capability to consent) or to the development of new treatments, for example in biomedicine, prosthetics, enhancement, etc. Key points are methodological questions of applied ethics, such as consideration of ethical and legal aspects as well as questions of justification							l ethics jectives, without sthetics, ethical
2	2 Learning objectives Students will have acquired higher level skills to theoretically and methodologically reflect, analyze and reason within the scientific area of applied medical ethics. They are able to relate questions of justification and practicability to one another, whilst considering different objective and disciplinary perspectives. They are able to theoretically and methodologicalleyanalyze current topics in medical ethics and, at the same time, to discern different levels (persons affected, institutional and social contexts), and to combine ethical perspectives (such as perspectives of individual, social, and legal ethics). They master different ethical approaches, have an understanding of their prerequisites and scopes, and can apply them in a way suitable to the respective context. Students have a deepened understanding of the subject and are capable of ethical assessment. They are able to work on specific topics and questions, and to present their results in a comprehensible way.							
3	Recommend A basic unde	led prerequisites for rstanding of ethics a	or participation and / or medical e	thics is desirable.				
4	Form of exa Module exam • Module The examina keynote pres	mination e exam (Study achie ation method will be entation (duration:	vement, Oral/wri e announced at th 20 min.) followed	tten examination, I e start of the first I by a discussion or	Default RS lesson. Pos writing a) ssible form protocol.	s are either g	;iving a
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MedTe	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Coι	ırses							
	Course nr. 18-mt-2210-	se Course name Current Issues	in Medical Ethics					
	Instructor Prof. Dr. Chr	istof Mandry				Type Seminar		SWS 2

Mo Ant	dule name hropological	and Ethical Issues of	Digitization				
Mo	dule nr. mt-2220	Credit points	Workload 90 h	Self-study 60 h	Module duration	Module cycle	
Lar Ger	nguage man	0.01		Module owner Prof. Dr. Christof	Mandry		
1	1 Teaching content In this seminar, we will analyze current and developing applications of digitization and AI in different areas of life, and also discuss them with regard to the perspectives of philosophy of technology, anthropology and ethics. In doing so, we will deal with fundamental questions such as the relationship between man and technology, the autonomy of autonomous systems, or the meaning of "responsibility", "action" or "intelligence" in the context of digitality and AI. Also, the seminar deals with the generic anthropological and ethical analysis and evaluation of particular scopes of application, in which digitization or AI play a key role, such as healthcare (health apps, big data mining, care robots), transportation (autonomous driving) etc., whilst applying interdisciplinary approaches like ethical design, algorithmic ethics, and privacy.						
2	2 Learning objectives Students are familiar with fundamental concepts of digitization and AI, and are able to take position in related discussions, for example regarding subject status, intelligence and capability of action, as well as the moral capacity of digital systems and systems involving AI. They are familiar with theories of technological development, like the theory of singularity, and the respective anthropological and ethical challenge involved. They are familiar with the approaches of philosophy and ethics of technology, for example digital design, as well as with critical stances regarding data security / privacy, and are able to apply them in certain scopes and with regards to particular developments. Students are able to analyze and present exemplary applications and developments regarding their technological, social and ethical aspects, and to profoundly discuss them with regard to their ethical and anthropological issues. In doing so, they are able to apply different approaches of ethics of technology and social ethics						
3	Recommen	ded prerequisites fo	or participation				
4	Form of exa Module exa • Modul The type of moderation	amination m: le exam (Study achie examination will be a or oral examination.	vement, Oral examinnounced in the f	nination, Default F irst lecture. Possible	S) e types include preser	ntation (20 minutes),	
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation				
6	 6 Grading Module exam: • Module exam (Study achievement, Oral examination, Weighting: 100 %) 						
7	Usability of M.Sc. MedT	f the module Tec					
8	Grade bonu	is compliant to §25	(2)				
9	References						
Cot	ırses						

Course nr. 18-mt-2220-se	Course name Anthropological and Ethical Issues of Digitization		
Instructor Prof. Dr. Christof	Mandry	Type Seminar	SWS 2

Mo Me	Module name Medical Data Science						
Mo	dule nr. mt-2230	Credit points	Workload	Self-study	Module duration	Module cycle	
Lar	nguage man/English		00 11	Module owner Prof. Dr. Holger S	Storf	Summer term	
1	1 Teaching content Students will attend a regular series of lectures and seminars (colloquium) in which they obtain extensive information about theory as well as practical experiences from the fields of medical informatics and medical data science. In these regular talks, members of the Medical Informatics Group, staff from the data integration centre as well as national and international speakers present timely and relevant topics from the field. The schedule will be provided in time. Topics: • Set up and establishment of patient registries • Anonymization of public health data • Consent and data protection • Overview of research infrastructure in medical informatics and related disciplines • Development of software solutions for applications and application management						
2	Learning of Students sh • familia • know • under • under • get a p	bjectives nall: arize themselves with methodologies in me stand data exploiration stand inderdisciplina possibility for networ	n timely topics fro dical informatics on and usage of m ry research appro king	m the field of medi and their applicatic nedical data aches	cal informatics ons		
3	Recommen	ded prerequisites fo	or participation				
4	Form of exa Module exa • Modul The type of	amination m: le exam (Study achie examination will be a	vement, Written e announced in the	xamination, Defau first lecture. Possib	lt RS) de types include repo	orts or protocols.	
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation				
6	 6 Grading Module exam: • Module exam (Study achievement, Written examination, Weighting: 100 %) 						
7	Usability of M.Sc. MedT	f the module Tec					
8	8 Grade bonus compliant to §25 (2)						
9	References Recent publ	ications of the speake	ers (will be annou	nced)			
Coi	Courses						

Course nr. 18-mt-2230-ko	Course name Medical Data Science		
Instructor		Type Colloquium	SWS 1

Mo	Module name Sominar Madical Data Science - Madical Informatica						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
Lar	nguage man/English	101	120 11	Module owner Prof. Dr. Holger S	Storf		
1	 Teaching content In the problem of the selected topics of recent conference and journal papers in the field of medical data science / medical informatics and finalize the course with an oral presentation. • critical reflections on the selected topic • further reading and individual literature review • preparation of a presentation (written and powerpoint) about the selected topic • presenting the talk in front of a group with heterogeneous prior knowledge • specialist discussion about the selected topic after the presentation The topics will derive from diverse medical applications from the field of medical data science / medical informatics informatics informatics such as standardized exchange formats of medical data or technical and semantic interoperability. 						
2	 2 Learning objectives After successful completion of the module, students are able to independently work themselves into a topic using scientific publications. • They learn to recognize relevant aspects of the selected study and to comprehensibly present the topic in front of a heterogeneous audience using different presentation techniques. After successful completion of the module, students are able to independently work themselves into a topic using scientific publications. 					ves into a topic using 7 present the topic in ves into a topic using	
3	Recomment	ded prerequisites fo	or participation				
4	Form of exa Module exa • Modul Details of th	amination m: e exam (Study achie e exam will be anno	vement, Oral/wri unced at the begir	tten examination, I nning of the course	Default RS) [presentation (30 m	inutes) and report].	
5	Prerequisite Passing the p The module courses offer the seminar. Please note Main.	e for the award of c module is passed if the final red. The qualification Attendance regulat	redit points module examinati objectives of the r ion according to th	on has been passed nodule can only be ne framework regul	and the student has achieved through reg ations of Goethe Uni	attended 80% of the gular participation in versity Frankfurt am	
6	 6 Grading Module exam: • Module exam (Study achievement, Oral/written examination, Weighting: 100 %) 						
7	Usability of M.Sc. MedT	the module					
8	Grade bonu	is compliant to §25	(2)				
9	References To be annou	unced during the cou	rse.				
Coi	Courses						

Course nr. 18-mt-2240-se	Course name Seminar Medical Data Science - Medical Informatics		
Instructor Prof. Dr. Holger S	Storf	Type Seminar	SWS 2

Mo	dule name		- M.J. 17 C					
Pro	ject seminar , dule pr	,Medical Data Scienc	e - Medical Inform	Solf study	Modulad	luration	Modulo av	elo
18-	mt-2250	6 CP	180 h	120 h	1 Term	luration	Winter tern	n
Lar Ger	iguage man/English	1		Module owner Prof. Dr. Holger S	Storf		I	
1	1 Teaching content In this project seminar "Medical Data Science - Medical Informatics", students are involved in planning, realization and further development of novel applications. This practical course covers topics such as data acquisition and data processing in the clinic for example for health care and research, for patient registries or for further innovative topics of public-funded research projects.					lization ion and further		
2	Learning of	ojectives						
	 Knowledge: In this project seminar, students will get practical training in the field of medical informatics through active integration into the working group and learn about typical challenges in the clinical context such as data protection or data integration. Furthermore, knowledge about medical classifications and standardized exchange formats will be conveyed. Skills: Students will deepen their skills in software development particularly through their active integration into open source projects in the clinical context as well as the communication/networking within software projects. Competences: Participants will be able to apply and largely independently develop discipline-relevant technologies. In group work, they acquire the ability for independent realization of elements of larger software solutions. 				rmatics context ons and gration oftware elevant f larger			
3	Recommen	ded prerequisites fo	or participation					
4	Form of exa Module exa • Modul The type of o documentat	amination m: e exam (Study achie examination will be a ion.	vement, Oral/wri nnounced in the f	tten examination, I irst lecture. Possible	Default RS) e types incl	ude presei	ntation (30 m	inutes),
5	Prerequisite Passing the	e for the award of c	redit points ation					
6	Grading Module exa • Modul	m: e exam (Study achie	vement, Oral/wri	tten examination, V	Weighting:	100 %)		
7	Usability of M.Sc. MedT	the module ec						
8	Grade bonu	is compliant to §25	(2)					
9	9 References Will be announced during the project seminar.							
Coi	ırses							
	Course nr. 18-mt-2250	-pj Project semina	ar "Medical Data S	cience - Medical Ir	oformatics"			
	Instructor Prof. Dr. Ho	lger Storf				Type Project se	eminar	SWS 4

2.8 Mandatory modules of M.Sc. programs from other departments

Module Introdu	Module name Introduction to Business Administration					
Module	e nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Langua German		3 CP	90 11	Module owner Prof. Dr. rer. pol.	Dirk Schiereck	Every Semester
1 Tea Thi cou scie adr Ma per rep	1 Teaching content This course serves as an introduction into studies of business administration for students of other siences. The course will provide a broad spectrum of knowledge from the "birth" of business administration as an university science field until its fragmentation into many specialized disciplines. Core topics will include basics of business administration (definitions and German legal forms), some Marketing concepts, introduction into Production Management (business process optimization and quality management), basic knowledge of organisational and personnel related topics, fundamental concepts of finance and investment as well as internal and external reporting standards.					
2 Lea The Fur Afte	 Learning objectives The couse encourages students who have not been confronted with business studies before to think economicially Furthermore, it should enable students to better understand actions of managers and corporations in general. After the course students are able to comprehend the development in the history of business administration, apply essential marketing concepts, use fundamental methods in production management, economically valuate investment alternatives and understand important interrelations in financial accounting. 					o think economicially. porations in general.
3 Red Not	commend ne	led prerequisites fo	r participation			
4 For Mo	r m of exa odule exar • Module	mination n: e exam (Technical ex	amination, Exam	ination, Duration:	90 Min., Default RS)	
5 Pre Pas	erequisite ssing the e	e for the award of creater the award of creater the award of the award	redit points			
6 Gra Mo	ading odule exar • Module	n: e exam (Technical ex	amination, Exam	ination, Weighting:	100 %)	
7 Usa	ability of	the module				
8 Gra	ade bonu	s compliant to §25	(2)			
9 Ref The Dor	ferences ommen, J mschke, V rther litera	P. & Achleitner, A) V. & Scholl, A. (2008) ature will be announ	K. (2006): Allgem 3): Grundlagen de ced in the lecture	eine Betriebswirtso r Betriebswirtschaf	chaftslehre, 5. Aufl., V tslehre, 3. Aufl., Heid	Wiesbaden. delberg.

Co	Courses					
	Course nr. 01-10-0000-vl	Course name Introduction to Business Administration				
	Instructor		Type Lecture	SWS 2		

Mo Intr	dule name oduction to In	nnovation Manageme	ent			
Mo 01-	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lan Eng	i guage	3 Gr	90 H	Module owner Prof. Dr. Alexand	er Kock	Every Semester
1	1 Teaching content The lecture offers students an introduction to the topic of innovation management in companies. In times of disruptive and radical innovations, well-founded knowledge in innovation management is an elementary core competence of companies in order to stay competitive. After learning the conceptual basics, students learn about managing the different stages of the innovation process, from initiative to the adoption of an innovation. In addition, strategic aspects and the human side of innovation management will be introduced. The lecture thus forms an excellent thematic orientation and introduction for undergraduate students for the advanced courses of the master studies.					
2	 2 Learning objectives After the course students are able to give an overview of the components of the innovation process and management. identify and evaluate problems that arise in the management of innovations. explain, evaluate and apply theories of technology and innovation management. assess the basic design factors of a firm's innovation system. derive actions to improve innovation processes in companies. apply the concepts to practice-relevant questions. 					
3	Recommen Prerequisite Previous Kn	ded prerequisites fo s: none owledge: see initial s	or participation kills and basics in	business administr	ration	
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	amination, Writte	en examination, Du	ration: 90 Min., Def	ault RS)
5	Prerequisite Passing the	e for the award of c Examination	redit points			
6	Grading Module exan • Modul	m: le exam (Technical ex	amination, Writte	en examination, We	eighting: 100 %)	
7	Usability of B.Sc. Wirtsc	the module haftsingenieurwesen	, B.Sc. Wirtschaft	sinformatik		
8	Grade bonu	is compliant to §25	(2)			
9	 References Hauschildt, J., Salomo, S., Schultz. C., Kock, A. (2016): Innovationsmanagement, 6. Aufl. Vahlen Verlag. Tidd/Bessant (2013): Managing Innovation: Integrating Technological, Market and Organizational Change. 					
Coι	Further liter	ature will be announ	ced in the lecture	•		

Course nr. 01-22-2B01-vl	Course name Introduction to Innovation Management		
Instructor Prof. Dr. Alexand	er Kock	Type Lecture	SWS 2

Mo Intr	dule name roduction to E	Intrepreneurship				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lan Eng	iguage Ilish	5 CP	90 11	Module owner Prof. Dr. rer. pol.	Carolin Bock	Every Semester
1	1 Teaching content The course "Grundlagen des Entrepreneurship" (Introduction to Entrepreneurship), being part of the module "Grundlagen Entrepreneurship" introduces concepts of entrepreneurship relying on basic concepts and definitions. Hereby, a global and international perspective is taken. The course includes the topics: actions of entrepreneurs, their motivations and idea generating processes, effectuation and causation, their decision-making, and en- trepreneurial failure. Concerning entrepreneurial businesses, business planning, growth models, strategic alliances of young ventures, and human and social capital of entrepreneurs are discussed, Further, special types of entrepreneurship are taught. In addition, workshops will give students an insight into practical methods such as design thinking and the implementation and identification of opportunities.					
2	 2 Learning objectives After the course students are able to define and describe basic concepts towards entrepreneurship, understand the psychologically-related concepts of being an entrepreneur, understand and describe the evolution from small firms to multinational enterprises, describe special types of entrepreneurship, understand basic concepts of entrepreneurial thinking towards idea- and business model creation, realize business opportunities and build sustainable business models, evaluate chances and risks of national and international markets as well choosing among various market entry strategies, incorporate stakeholder feedback into the business model. 					, odel creation, nong various market
3	Recomment Prerequisite Previous Kn	ded prerequisites fo s: none owledge: see initial s	r participation kills and basics in	business administr	ration	
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	amination, Writte	en examination, Du	ration: 60 Min., Def	ault RS)
5	Prerequisite Passing the	e for the award of c Examination	redit points			
6	 Grading Module exam: Module exam (Technical examination, Written examination, Weighting: 100 %) 					
7	Usability of B.Sc. Wirtsc	the module haftsingenieurwesen	, B.Sc. Wirtschaft	sinformatik		
8	Grade bonu	is compliant to §25	(2)			
9	References					

Grichnik, D., Brettel, M., Koropp, C., Mauer, R. (2010) Entrepreneurship. Stuttgart: Schäffer-Poeschel Verlag Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2010). Entrepreneurship (8th ed.). New York: McGraw-Hill. Read, S., Sarasvathy, S., Dew, N., Wiltbank, R. & Ohlsson, A.-V. (2010). Effectual Entrepreneurship. New York: Routledge Chapman & Hall.

More literature will be provided within the course and distributed to the students accordingly

Co	urses					
	Course nr. 01-27-1B01-vl	C ourse name Introduction to Entrepreneurship				
	Instructor Prof. Dr. rer. pol.	Carolin Bock	Type Lecture	SWS 3		

Mo Inti	Introduction to project management						
Mo 01-	dule nr. 19-0B03	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cycle Every Semester	
Lar Ger	iguage man			Module owner Prof. Dr. rer. pol.	Andreas Pfnür		
1	1 Teaching content Basic concepts, project organisation, planning a work breakdown structure, quantity and cost estimation, time, cost and capacity planning, project control, project risk management, financial planning of projects, selected problems of project leadership, Selected applications and case studies from project management					cost estimation, time, of projects, selected ement	
2	 2 Learning objectives After the course students are able to understand the basic tasks and challenges of project management, know different alternatives of the organization of the project management and to evaluate their specific advantages and disadvantages, demonstrate the various ways in which project committees can be set up and how they can be integrated into a company's organisation, understand and develop a project structure plan, understand and evaluate the procedures for estimating quantities and project costs, apply and evaluate state-of-the-art models and procedures for time, cost and resource planning, carry out in-depth procedures of project controlling and to learn how to apply them in specific situations. understand the basics of financial planning of a project. 					valuate their specific ey can be integrated ce planning, in specific situations.	
3	Recommend Prerequisites Previous Kno	ded prerequisites fo s: none owledge: see initial s	or participation				
4	Form of exa Module exar • Module	mination n: e exam (Technical ex	camination, Writte	en examination, Du	ıration: 90 Min., Defa	ault RS)	
5	Prerequisite Passing the e	e for the award of c	redit points				
6	 6 Grading Module exam: • Module exam (Technical examination, Written examination, Weighting: 100 %) 						
7	7 Usability of the module B.Sc. Wirtschaftsingenieurwesen, B.Sc. Wirtschaftsinformatik						
8	Grade bonu	s compliant to §25	(2)				
9	References						
Burghardt, M. (2008): Projektmanagement. Leitfaden für die Planung, Überwachung und Steuerung von Projekten (8., überarb. und erw. Aufl.). Erlangen: Publicis Corp. Publ.

Kerzner, H. (2006): Project Management - A Systems Approach to Planning, Scheduling, and Controlling (9. Aufl.). Hoboken, NJ: Wiley.

Madaus, B. (2000): Handbuch Projektmanagement (6., überarb. und erw. Aufl.). Stuttgart: Schäffer-Poeschel. Schwarze (2001) Projektmanagement mit Netzplantechnik, Herne, 8. Auflg.

Further literature will be announced in the lecture.

Courses

	Course nr. 01-19-5100-vu	Course name Introduction to Project Management		
Instructor		Andreas Pfnür	Type	SWS
Prof. Dr. rer. pol. Andreas Pfnür			Lecture and practice	2

Mo Inti	dule name	onomics (V)						
Mo 01-	dule nr. 60-1042/f	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module	duration	Module cy Every Seme	cle ester
Lar Ger	nguage man			Module owner Prof. Dr. rer. pol. Michael Neugart				
1	 Teaching content Economic modeling Supply and demand Elasticities Consumer and producer rent Opportunity costs Marginal analysis Cost theory Utility maximization Macroeconomic aggregates Long-run growth 							
2	Aggregate supply and aggregate demand Learning objectives							
3	Students are introduced to the principles of economics and their application to selected neids of interest. Recommended prerequisites for participation None							
4	Form of exam Module exam • Module	nination : exam (Technical e	xamination, Exam	ination, Duration:	90 Min., D)efault RS)		
5	Prerequisite Passing the fi	for the award of c nal module examin	e redit points ation					
6	Grading Module exam • Module	: exam (Technical e	xamination, Exam	ination, Weighting	: 100 %)			
7	Usability of t none	he module						
8	Grade bonus	compliant to §25	(2)					
9	References to be annound	ced in course.			_			
Co	urses							
	Course nr. 01-60-0000-v	Course name I Introduction t	o Economics					
	Instructor Type SWS Lecture 2					SWS 2		

Mo	dule name						
Che	emistry for Ene	ergy Scientists and H	Engineers				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cy	cle
07-	03-0305	5 CP	150 h	150 II 1 Term Every 2. Semester			mester
Enc	iguage alish			Prof Dr rer nat	Ulrike Kramm		
1	1 Teaching content Scientific fundamentals for chemical processes: Chemical thermodynamics; Ideal and real mixtures; Phase diagrams; Chemical kinetics; Catalysis; Electrochemistry. Chemistry of fuels. Knowledge of inorganic substances and materials relevant for energy conversion and the efficient usage of energy: Synthesis of characterization of solids; Oxides; Refractory materials; Ionic conductors; Electrode materials; Physical properties.						
2	2 Learning objectives Students gain basic knowledge in fundamentals of chemistry and chemical processes. They develop an under- standing of the principles and methods in chemistry. They understand the difference between classes of substances like organic fuels and inorganic materials for energy conversion. They know about general methods of chemical synthesis and characterization. They are capable to continue participating in advanced courses in chemistry.						
3	Recommend	ed prerequisites fo	or participation				
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Default RS) Fachprüfung: Written exam 90 min / Oral exam 30 min 						
5	Prerequisite Modulabschl	for the award of c ussleistung: Fachpr	r edit points üfung				
6	Grading Module exam • Module	i: exam (Technical e	xamination, Oral/	written examinatio	n, Weighting: 100 %))	
7	Usability of M.Sc. Energy	t he module Science and Engin	eering				
8	Grade bonus	s compliant to §25	(2)				
9	References To be annour	nced in the lecture.					
Co	urses						
	Course nr. 07-03-0301-v	Course name	Energy Scientists	and Engineers			
	Instructor			~	Type Lecture		SWS 0
	Course nr. 07-03-0301-1	Course name ue Übung Chemi	stry for Energy Sci	entists and Engine	ers		
	Instructor Type SWS Practice 0					SWS 0	

Mo Ma	dule name terials Science	e for Renewable Ener	gy Systems			
Mo	dule nr. 01-4404	Credit points	Workload 150 h	Self-study 105 h	Module duration	Module cycle Every 2. Semester
Lar Eng	nguage			Module owner Prof. DrIng. Oliv	ver Gutfleisch	
1	1 Teaching content • Introduction • Materials Criticality • Classifications of materials according to their physical properties • Structural Properties • Defects - Gutfleisch • Electronic properties I • Semiconductors • Solar Cells • Batteries and Fuel Cells • Dielectrics • Thermoelectrics • Magnetic Materials for Energy Applications I: Hard and soft Magnets for wind energy and E-mobility					
2	 Magnetic Materials for Energy Applications II: Solid state cooling Learning objectives General context is the recognition that the great transformation to renewable energy technologies is also a material transformation; in other words, the criticality of technology metals (introduced in the course) will affect the speed of the transformation. The basic concepts of materials science will be introduced with a main emphasis of physical properties as dependent of material's composition and microstructure, as well as defects, and on the combinations of materials. Selection criteria based on some initial understanding of some fundamental physics concepts such as various types of conductivity and electric properties for the application of materials will be developed for typical energy applications. The students should develop the competences to correlate basic materials properties and engineering strategies for various energy conversion devices (disciplinary expertise). They should be able to judge results from literature and news from media, and understand limitations and 					
3	Recomment None	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul Module Exa	mination m: e exam (Technical ex mination (Technical	kamination, Exam Examination, Writ	ination, Duration: ten Exam, Duratio	90 Min., Default RS) n 90 min, Standard)	
5	Prerequisite passing of ex	e for the award of c xam	redit points			
6	Grading Module exame • Modul	m: e exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of Master of Sc	the module	e and Engineering			
8	Grade bonu	is compliant to §25	(2)			
9	References					

M.F. Ashby and D.R.H. Jones, Engineering materials, Volumes I and II, Butterworth-Heinemann, Oxford UK (2006)

William D Callister Jr, David G. Rethwisch, Fundamentals of Materials Science and Engineering -An Integrated Approach, Third Edition, John Wiley & Sons, 2008

G. Gottstein, Physikalische Grundlagen der Materialkunde, Springer, also available in English: G. Gottstein, Physical Foundations of Material Science, Springer

Charles Kittel, Introduction to solid state physics, 8th edition, Wiley&Sons

R. O'Handley, Modern Magnetic Materials, John Wiley & Sons, 2000,

J.M.D. Coey: Magnetism and Magnetic Materials, Cambridge University Press, 2010

Safa O. Kasap, Principles of Electronic Materials and Devices, McGraw-Hill, 3rd edit., 2005 H. Julian Goldsmid, Introduction to Thermoelectricity, Springer Series in Materials Science, Vol. 121, 2009

Courses

Course nr. 11-01-4404-vl	Course name Materials Science for Renewable Energy Systems		
Instructor		Type Lecture	SWS 2
Course nr. 11-01-4404-ue	Course name Exercises Materials Science for Renewable Energy Systems		
Instructor		Type Practice	SWS 1

Mo Ene	dule name ergy Technolog	gies in Civil Enginee	ring and Architect	ure				
Mo 13-	dule nr. C0-M025	Credit points 5 CP	Workload 150 h	Self-study 120 h	Module d	luration	Module cyc Every 2. Se	cle mester
Lar Eng	iguage glish		l	Module owner Prof. DrIng. Ulrich Knaack				
1	Teaching co - Basics of su - Building ph - Passive and - Energy effic - Political an - Case examp	ntent Istainable construction Istainable construction	on / buildings and nergy efficiency as a conditions	l urban planning nd building service	S			
2	2 Learning objectives Students develop a basic understanding of energy efficiency and energy technologies in construction, both in the building and urban context, taking into account technical, economic, social and environmental aspects. They are familiar with the concepts of sustainable construction, building physics, active and passive building systems and energy-efficient construction in buildings as well as in housing areas and districts. Students have the ability to weigh up different solutions, to explain them objectively and understandably, to make decisions and give reasons for them. Students are able to present the results of their work iin a suitable form.							
3	Recommended prerequisites for participation							
4	Form of exa Module exar • Modul • Modul Study Exam	mination n: e exam (Technical e: e exam (Study achie ination: preparation	xamination, Exam vement, Homewo of a project descr	ination, Duration: rk, worksheet, p/n iption and discussio	90 Min., Do p RS) on	efault RS)		
5	Prerequisite Passing the 1	e for the award of c nodule examination	redit points (s)					
6	Grading Module exar • Modul • Modul	n: e exam (Technical e: e exam (Study achie	xamination, Exam evement, Homewo	ination, Weighting rk, worksheet, Wei	: 1) ghting: 0)			
7	Usability of M.Sc. Energ	the module y Science and Engin	eering					
8	Grade bonu	s compliant to §25	(2)					
9	References Literature w	ill be announced in	the course.					
Cot	urses	1						
	Course nr. 13-C0-0038-	vl Energy Techno	ologies in Civil Eng	gineering and Arch	itecture			
	Instructor					Type Lecture		SWS 2

Mo Ene	dule name ergy Technolo	gies in Mechanical E	ngineering					
Mo	dule nr.	Credit points	Workload	Self-study	Module dur	ation	Module cyc	cle
Lan Eng	iguage glish	5.61	130 11	Module owner Prof. DrIng. Chr	istian Hasse		Every 2. Se	lifester
1	Teaching co Technical th thermodyna	ontent lermodynamics, stat mics, exergy and an	e values and equa ergy, cyclic process	ations of state for g ses in thermodynar	gases, types o nics, design of	f energ f power	y, 1. and 2.	Law of sses
2	 2 Learning objectives On successful completion of this module, students should be able to: 1. Explain and make use of the relationship between thermal and caloric state properties and state values. 2. Distinguish and define the different types of energies (e.g. work, heat, internal energy, enthalpy). 3. Analyse technical systems and processes by setting up energy balances and using equations of state. 4. Evaluate the quality of energy transfer processes by using entropy balances and looking at exergy. 5. Characterize the thermal behavior of gases, liquids and solid bodies as well as their respective phase changing processes. 6. Make use of this knowledge to analyze and describe machines (turbines, pumps etc.) and energy transfer processes (internal combustion engines, steam power plants, refrigerators, heat pumps). 							
3	Recommended prerequisites for participation Basic knowledge in mathematics and physics.							
4	 Form of examination Module exam: Module exam (Technical examination, Oral/written examination, Default RS) Oral (20 min) or written exam (90 min) 							
5	Prerequisite Passing the	e for the award of c examination	redit points					
6	Grading Module exan • Modul	n: e exam (Technical e:	xamination, Oral/	written examinatio	n, Weighting:	100 %)	
7	Usability of M.Sc. Energ	the module y Science and Engin	eering					
8	Grade bonu	s compliant to §25	(2)					
9	 9 References Lecture slides available via TUCaN. Book: P. Stephan, K. Schaber, K. Stephan, F. Mayinger: Thermodynamik Bd. 1 Einstoffsysteme, Springer 2005 							
Coι	ırses							
	Course nr. 16-13-6420	vl Energy Techno	ologies in Mechan	ical Engineering				
	Instructor				Ty Le	pe ecture		SWS 2

Course nr. 16-13-6420-ue	Course name Energy Technologies in Mechanical Engineering		
Instructor		Type Practice	SWS 2

Mo TK3	dule name 3: Ubiquitous	/ Mobile Computing									
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle					
Lar	nguage	0 CP	180 11	Module owner							
Ger	rman			Prof. Dr. rer. nat.	Eberhard Mühlhäus	er					
1	 Teaching content Objectives: Knowledge of technical basics of the mobile communication Knowledge of important challenges of the Ubiquitous Computing Methodic knowledge about current approaches to these challenges Course Content: Introduction to Ubiquitous Computing Mobile Communication Internet of Things: RFID and Smart Items Service Discovery & Cloudlets Context- and Location-aware Computing 										
	 - Human Computer Interaction - Privacy and Trust in Ubiquitous Computing 										
2	Learning objectives After successfully attending the course, students are familiar with the technical basis of mobile communication. They understand the fundamental challenge of ubiquitous computing. They know current approaches to solve these challenges. They are able to apply their knowledge to build ubiquitous computing systems.										
3	Computer N	ded prerequisites for etzwerke and Distrib	uted Systems								
4	Form of exa Course relat • [20-00	mination ed exam:)-0120-iv] (Technical	examination, Ora	al/written examina	tion, Default RS)						
5	Prerequisite Pass exam (2	e for the award of c 100%)	redit points								
6	Grading Course relat • [20-00	ed exam:)-0120-iv] (Technical	examination, Ora	al/written examina	tion, Weighting: 100	%)					
7	Usability of the module B.Sc. Informatik M.Sc. Informatik M.Sc. Wirtschaftsinformatik B.Sc. Psychologie in IT Joint B.A. Informatik B.Sc. Sportwissenschaft und Informatik M.Sc. Sportwissenschaft und Informatik May be used in other degree programs.										
8	Grade bonu	s compliant to §25	(2)			Grade bonus compliant to §25 (2)					

	In dieser Vorlesu Novelle der APB u um bis zu 1.0 fül	ng findet eine Anrechnung von vorlesungsbegleitenden Leistu Ind den vom FB 20 am 30.3.2017 beschlossenen Anrechnungsreg Irren kann.	ngen statt, die lt. 25 (2 geln zu einer Notenverbe	2) der 5. sserung	
9	References Literature recommendations will be updated regularly, an example might be: A Primary Literature:				
	Handbook of Research: Ubiquitous Computing Technology for Real Time Enterprises edited by Prof. Dr. Max Mühlhäuser, Dr. Iryna Gurevych, 2008, Information Science Reference, ISBN-10: 1599048329				
	B Secondary Literature:				
	 F. Adelstein, S. Gupta et al.: Fundamentals of Mobile & Pervasive Computing McGraw Hill 2004, Stefan Poslad: Ubiquitous Computing, Wiley 2009, ISBN 978-0-470-03560-3 Kapitel Mobilkommunikation: M. Sauter: Grundkurs Mobile Kommunikationssysteme: UMTS, HSDPA und LTE, GSM, GPRS und Wireless LAN; Vieweg-Teubner Studium 2010 J. Krumm (Ed.): Ubiquitous Computing Fundamentals, CRC Press 2010 D. Cook, S. Das (Ed.): Smart Environments, Wiley 2005 				
Co	urses	Г <u> </u>			
	Course nr. 20-00-0120-iv	Course name TK3: Ubiquitous / Mobile Computing			
	Instructor		Type Integrated course	SWS 4	

Mo Alg	Module name Algorithms for Electronic Decign Automation Tools						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
20-	00-0183	3 CP	90 h	60 h	1 Term	Winter term	
Lar	iguage			Module owner	1		
Ger	man/English			Prof. DrIng. And	Ireas Koch		
1	 The VLSI design problem Fundamental graph representations and algorithms Representations for hierarchical circuits Fabrication technologies for integrated circuits Layout compaction Timing analysis Heuristical optimization techniques Placement problems, algorithms, and cost functions Exact optimization techniques Partitioning and its use in placement Floorplanning problems, representations, and techniques Routing problems, algorithms, and cost functions 						
2	 2 Learning objectives After successfully attending the course, the students know a number of fabrication technologies for integrated circuits. They are able to deduce from the technologies the requirements on automation tools for the different tasks in the design and realization process. They are familiar with modeling technological problems by formal concepts such as graphs and equation systems. They understand fundamental techniques for solving even hard computational problems and are able to apply these, together with knowledge of representative EDA algorithms, to device provide the provide the statement of the statem						
3	Recommend Recommend Participation tierte Progra	ded prerequisites fo ed: of lecture "Digitalte ummierung".	or participation	en und Datenstruk	turen" and "Funktior	nale und objektorien-	
4	Form of exa Course relat • [20-00	mination ed exam:)-0183-vl] (Technical	examination, Ora	ıl/written examina	tion, Default RS)		
5	Prerequisite Pass exam (2	e for the award of c 100%)	redit points				
6	Grading Course relat • [20-00	ed exam:)-0183-vl] (Technical	examination, Ora	ıl/written examina	tion, Weighting: 100	%)	
7	Usability of	the module					

8	B.Sc. Informatik M.Sc. Informatik B.Sc. Computatio M.Sc. Computatio M.Sc. Wirtschaft B.Sc. Psychologie Joint B.A. Inform B.Sc. Sportwisse M.Sc. Sportwisse May be used in o Grade bonus com	onal Engineering onal Engineering sinformatik e in IT atik nschaft und Informatik enschaft und Informatik ther degree programs. mpliant to §25 (2)			
9	ReferencesLiterature reommendations will be updated regularly, an example might be:Gerez: Algorithms for VLSI Design AutomationWang/Chang/Cheng: Electronic Design Automation				
Cot	urses				
	Course nr. 20-00-0183-vl	Course name Algorithms for Chip Design Tools			
	Instructor		Type Lecture	SWS 2	

Mo Lab	dule name os on Algorith	ms for Electronic Des	ign Automation T	ools		
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
Lar Ger	nguage rman/English	0.01	100 11	Module owner Prof. DrIng. And	Ireas Koch	winter term
1	 Teaching content Realizing Electronic Design Automation tools for layout synthesis, specifically for topics such as timing analysis, placement, and routing Evaluation of the quality-of-results and compute/memory requirements of developed tools in comparison to existing implementations 					
2	2 Learning objectives After successfully attending the course, the students can independently implement Electronic Design Automation tools for the specified fabrication technology. They can evaluate their tools according to a number of quality metrics and perform a comparison with existing implementations.					
3	Recommend Recommend Participation	ded prerequisites fo led: 1 of lecture "Algorithi	or participation nen für Hardware	e-Entwurfswerkzeu	ge".	
4	Form of exa Course relat • [20-00	amination ed exam:)-0571-pr] (Study ac	hievement, Oral/v	written examination	n, Default RS)	
5	Prerequisite Pass exam (e for the award of c 100%)	redit points			
6	Grading Course relat • [20-00	ed exam:)-0571-pr] (Study ac	hievement, Oral/v	written examination	n, Weighting: 100 %)
7	Usability of B.Sc. Inform M.Sc. Inform B.Sc. Comp M.Sc. Comp M.Sc. Wirtse B.Sc. Psycho Joint B.A. In B.Sc. Sportv M.Sc. Sportv M.Sc. Sportv	the module natik natik utational Engineering outational Engineering chaftsinformatik ologie in IT formatik vissenschaft und Info wissenschaft und Info d in other degree pro	g g ormatik ormatik grams.			
8	Grade bonu	is compliant to §25	(2)			
9	References Given scient	ific Papers to recomm	neded base-metho	ods.		
Coi	urses	Courses				

Course nr. 20-00-0571-pr	Course name Labs on Algorithms for Electronic Design Automation Tools		
Instructor Prof. DrIng. And	lreas Koch	Type Lab	SWS 4

Mo Arc	dule name hitecture and	Design of Computer	Systems				
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
Lar Ger	nguage man	50	130 11	Module owner Prof. Dr. phil. nat	. Marc Fischlin	winter term	
1	1 Teaching content - Technological foundations and trends in micro electronics - Design flows for microelectronic systems - Description of hardware systems - Characteristics of computing systems - Architectural support for parallel execution - Memory systems - Heterogeneous systems-on-chip - On-chip and off-chip communication structures - Embedded systems, including in context of cyber-physical systems						
2	2 Learning objectives After successfully attending the course, students are familiar with functional and non-functional requirements for heterogeneous discrete and integrated computing systems. They understand the techniques for realizing such systems and can use design methods and tools to apply the techniques to independently implement computing systems (or components thereof) that fulfill the given requirements. They are able to evaluate computing systems in a number of quality metrics.						
3	Recommend Recommend Pass of lectu	ded prerequisites fo led: re "Digitaltechnik" a	or participation nd "Rechnerorgan	isation", respective	ely according knowle	dge.	
4	Form of exa Course relat • [20-00	mination ed exam:)-0012-iv] (Technical	examination, Ora	al/written examina	tion, Default RS)		
5	Prerequisite Pass exam (2	e for the award of c 100%)	redit points				
6	Grading Course relat • [20-00	ed exam:)-0012-iv] (Technical	examination, Ora	al/written examina	tion, Weighting: 100	1%)	
7	 ⁷ Usability of the module B.Sc. Informatik B.Sc. Wirtschaftsinformatik B.Sc. Psychologie in IT Joint B.A. Informatik B.Sc. Sportwissenschaft und Informatik B.Sc. Informationssystemtechnik May be used in other degree programs. 						
8	Grade bonu	s compliant to §25	(2)				
9	References						

	Literature recom Nikhil/Czeck: Bl Arvind/Nikhil/Ei Hennessy/Patter	mendations will be updated regularly, an example might be: uespec by Example ner/Vijayaraghavan: Computer Architecture: A Constructive A con: Computer Architecture - A Quantitative Approach	Approach	
	Crockett/Elliott/	Enderwitz/Stewart: The Zyng Book		
	Flynn/Luk: Com	outer System Design		
	Sass/Schmidt: E	nbedded Systems Design		
Co	urses			
	Course nr. 20-00-0012-iv	Course name Architecture and Design of Computer Systems		
	Instructor		Type Integrated course	SWS 3

Mo Inti	dule name	Compiler Construction	n			
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
20-	00-0904	5 CP	150 h	105 h	1 Term	Winter term
Ger Ger	iguage man			Prof. Dr. phil. nat	t. Marc Fischlin	
1	 Teaching content Structure of compilers Context-free grammars for the description of language syntax Lexing and parsing techniques Intermediate representations Semantic analysis Run-time organisation Code generation Software tools for compiler constructions Implementation techniques for compilers 					
2	Learning of After succes formal conce concepts with language to apply these	bjectives sfully attending the c epts for the descriptio th algorithmic technic a given target machin together with manua	course, students as n of syntax and se jues to independe ne. They know sof l techniques to in	re familiar with the mantics of program ntly construct a cor tware tools support plement the comp	e structure of compile nming languages. The npiler that maps a sp ting the construction ilers.	ers. They understand ey can combine these ecified programming of compilers and can
3	Recomment Recomment Participation and "Rechne	ded prerequisites for ded: n of lecture "Algorithm erorganisation", respo	or participation nen und Datenstru ectively according	kturen", "Funktion <i>a</i> knowledge.	ıle und objektorientie	rte Programmierung"
4	Form of exa Course relat • [20-00	amination ted exam: 0-0904-iv] (Study acl	nievement, Oral/v	vritten examinatior	ı, Default RS)	
5	Prerequisit Pass exam (Course achi discussion o	e for the award of c (100%) ievement may be ac on colloquiums. Each	redit points quired through e area must be pass	xercises, hands-on sed.	training, programn	ning and successfull
6	Grading Course relat • [20-00	ted exam: 0-0904-iv] (Study acl	nievement, Oral/v	vritten examinatior	n, Weighting: 100 %)	
7	Usability of the module B.Sc. Informatik B.Sc. Informationssystemtechnik May be used in other degree programs.					
8	Grade bonu	us compliant to §25	(2)			
9	References Literature recommendations will be updated regularly, an example might be: Watt/Brown: Programming Language Processors in Java					
Coi	irses					

Course nr. 20-00-0904-iv	Course name Introduction to Compiler Construction		
Instructor Prof. DrIng. And	dreas Koch	Type Integrated course	SWS 3

Mo Cor	dule name npiler Tooling	ţ				
Mo 20-	dule nr. 00-1013	Credit points 6 CP	Workload 180 h	Self-study 120 h	Module duration	Module cycle Winter term
Language Module owner German/English Prof. DrIng. Andreas Koch			1			
1	1 Teaching content Modern compilers are primarily designed to produce efficient code for a particular platform and in doing so they employ sophisticated analysis and transformation tools. Such an infrastructure is useful also for source code transformation, e.g. for tools to annotate, instrument, or canonicalize codes. The complexity of C++ makes the development of such tools a challenging task. An open compiler infrastructure used in a variety of research and production compilers is the LLVM infrastructure (www.llvm.org). A well-established front-end for C, C++ and objective C is Clang, which provides powerful mechanisms for extracting information from an abstract syntax tree representation of the underlying code, and thus enables source code modifications as well as the generation of the LLVM intermediate representation.					
	implement p handling an various facet between the coding stand	practical exercises for d matching of the C s of code augmentati static analysis and r lards.	or source transform lang abstract synt ion or refactoring, runtime environme	mation. The Clang cax tree. Examples e.g. for instrument ent of (parallel) co	/LLVM techniques in for source transform ing parallel codes, for des, or for code refac	nclude, in particular, nation will highlight r passing information ctoring to conform to
2	Learning of After attend analysis and and impleme and decide o additional us	ojectives ing this course, the source transformatio ent custom static ana on the appropriate lev sage scenarios for co	students know ba on for C++, based alysis and code tra rel of abstraction o mpiler technology	nsic and advanced on the Clang/LLVM Insformation tools f the code represen	concepts of syntactic I technology. In partic using the Clang/LLVI tation for the task at 2	c and semantic code cular, they can design M framework, reflect hand, and synthesize
3	Recommended Lecture Intro- edge of C++	ded prerequisites fo oduction to Compiler +	or participation Construction (EiC	B), Lecture System	- and Parallel Program	mming (SPP), Knowl-
4	Form of exa Course relat • [20-00	mination ed exam:)-1013-pr] (Study ac	hievement, Oral/v	written examination	n, Default RS)	
5	Prerequisite Pass exam (2	e for the award of c 100%)	redit points			
6	 6 Grading Course related exam: • [20-00-1013-pr] (Study achievement, Oral/written examination, Weighting: 100 %))
7	Usability of B.Sc. Inform M.Sc. Inform May be used	the module atik natik in other degree pro	grams.			
8	Grade bonu	s compliant to §25	(2)			
9	References					

Co	Courses						
Course nr.Course name20-00-1013-prCompiler Tooling							
	Instructor Prof. DrIng. And	dreas Koch	Type Lab	SWS 4			

Mo	dule name						
Ma	Machine Dynamics						
Mo	dule nr. 98-4094	Credit points	Workload	Self-study	Module duration	Module cycle	
Lar	nguage	0.01	100 11	Module owner	1 ICIIII	Every 2. Semester	
Ger	rman			Prof. DrIng. Tob	ias Melz		
1	1 Teaching content Vibration Systems in Mechanical Engineering. Problems of Advanced Machine Dynamics. Elements (parameter) of mechanical vibration systems in machines and structures. Modelling and equations of motion of linear vibration systems for machines and structures. Input-output relations, excitation and vibration response signals in the time and frequency domain. Natural vibrations of linear SDOF- and MDOF systems, eigenvalues and eigenvectors, orthogonality. Forced vibrations of linear SDOF- and MDOF systems due to different excitations. Influence of (multiphysical) interactions (structure, fluid, electric and magnetic fields) on the vibration behavior. Vibration monitoring and diagnosis. Measures for vibration control.						
2	 2 Learning objectives On successful completion of this module, students should be able to: 1. Work on basic problems in machine and structural dynamics and to find practical solutions. 2. Model real mechanical vibration systems (machines and structures) and to derive the equations of motion based on the principles of mechanics. 3. Determine and to analyse the dynamic characteristics (natural frequencies, damping behavior, vibration modes) of machines and structures. 4. Calculate forced vibrations (system responses) of machines and structures due to different types of excitations and to interpret the solutions. 5. Fundamentally recognize, to plan and to evaluate experimental investigations of vibration systems (frequency response, system identification, modal analysis). 6. Plan vibration monitoring and diagnosis for machines. 						
3	Recommen Technical M	ded prerequisites for echanics I to III (Stat	or participation tics, Elastomechar	nics, Dynamics) and	l Mathematics I to III	I recommended.	
4	Form of exa Module exa • Modul	amination m: e exam (Technical ex	xamination, Exam	ination, Duration:	150 Min., Default RS))	
5	Prerequisit Passing the	e for the award of c	redit points				
6	Grading Module exam:Module exam (Technical examination, Examination, Weighting: 100 %)						
7	 7 Usability of the module Master MB Ia Grundlagen Master MB SP FAS WPB Ia Pflicht WPB Master PST III (Fächer aus Natur- und Ingenieurwissenschaft für Papiertechnik) WI/MB, Master Mechatronik 						
8	Grade bonu	is compliant to §25	(2)				

9	References Markert, R.: "Strukturdynamik", Shaker, 2013. Dresig, H.; Holzweißig, F.: "Maschinendynamik", 10. Auflage, Springer, 2011. Gasch, R.; Nordmann, R.: "Rotordynamik", 2. Auflage, Springer,2005. Dresig, H.: "Schwingungen mechanischer Antriebssysteme", Springer 2001. Fischer U.: Stephan W.: Mechanische Schwingungen" 3. Auflage Fachbuchverlag Leipzig, 1993.						
Co	urses						
	Course nr.Course name16-98-4094-vlMachine Dynamics						
	Instructor		Type Lecture	SWS 3			
	Course nr.Course name16-98-4094-hüMachine Dynamics						
	Instructor		Type Lecture hall practice	SWS 1			

Mo Ma	Module name Machine Learning Applications						
Module nr. Credit points Worklos			Workload	Self-study	Module duration	Module cycle	
Lar Eng	98-4174 Iguage glish	0 CP	180 II	Module owner Prof. DrIng. Uw	e Klingauf	Every 2. Semester	
1	English Prof. DrIng. Uwe Klingauf 1 Teaching content Theory: Application-oriented basics of machine learning and related areas statistics (descriptive, explorative, inductive), advanced analytics, data mining, data science and big data; basics of machine learning methods, functions and algorithms; development processes; basics of data science principles and techniques: discussion of business scenarios; collection, review and quality evaluation of data; data preparation, feature engineering; application of methods and use of program systems on the basis of examples; identification and evaluation of possible solutions; model selection, optimization, performance-assessment; essential ideas of model integration in decision-making processes, recommendations for actions, system of systems; examples from current research, e.g. predictive maintenance in aviation and production;Practical group work: Application of basic features of a software development methodology (e.g. scrum); application of theoretical knowledge on a cooperative development task; practical solution development of an industrial challenge through programming and data evaluation (implementation): documentation and presentation of the results.						
2	 2 Learning objectives On successful completion of this module, students should be able to: Assess and evaluate basic developments and possible uses of artificial intelligence (machine learning) in engineering applications (e. g. mechanical engineering). Differentiate and explain key concepts and (mathematical) methods of machine learning Evaluate selected algorithms and models (e.g. from the diagnostic/prognostic domain) with regard to their performance, robustness and quality from an engineering point of view. Apply learned competencies in the areas of data acquisition and processing, data-based modelling (diagnosis and prognosis) and prescription. Structure simple and medium analytical tasks independently by means of standardized processes (CRISP/OSA- 						
3	Recomment Programmin	ded prerequisites fo ng knowledge in Mat	or participation ab and/or Python	is required.			
4	Form of exa Module exar • Modul Course relat • [16-98 50 % writter of results, 13 Grading syst	mination m: e exam (Technical ex ed exam: 3-4174-pr] (Technica n exam (60 min.) and 5 min) of a cooperati rem: Technical Exam	xamination, Exam l examination, Sp special form: 50 % ve development ta inations (both 50%	ination, Duration: ecial form, Default % documentation, p ask ("Data Quest"). %); Standard (Nun	60 Min., Default RS) RS) program code and ora nber grades).	l exam (presentation	
5	Prerequisite for the award of credit points Passing both examinations						
6	 Grading Module exam: Module exam (Technical examination, Examination, Weighting: 50 %) Course related exam: [16-98-4174-pr] (Technical examination, Special form, Weighting: 50 %) 						
7	Usability of Master MB I WPB Master	the module b Digitalisierung PST III (Fächer aus	Natur- und Ingeni	eurwissenschaft fü	r Papiertechnik)		

8	Grade bonus co	mpliant to §25 (2)					
9	References						
	Lecture material	via moodle.					
	Ertel: Grundkurs	s künstliche Intelligenz, Springer					
	Mitchell: Machin	ne Learning, McGraw Hill					
	Hastie: The Elen	nents of Statistical Learning, Springer					
	Witten: Data Mi	ning, Elsevier					
Co	urses						
	Course nr.	Course name					
	16-98-4174-vl	Machine Learning Applications					
	Instructor		Туре	SWS			
			Lecture	3			
	Course nr.	Course name					
	16-98-4174-pr Machine Learning Applications (Group Work)						
	Instructor		Туре	SWS			
			Lab	1			

Mo	dule name	ds in Product Develo	nment			
Mo	dule nr. 05-5080	Credit points 4 CP	Workload 120 h	Self-study 60 h	Module duration	Module cycle Summer term
Lar Ger	nguage rman		120 11	Module owner Prof. DrIng. Eck	hard Kirchner	
1	Teaching co Basics of pr requirement of manufact developmen of products Production i	ontent oduct development t list, basics of develo curing costs, value ar t of products and proc designed for safety in a globalized world	and structuring of opment of new pr nalysis and target luct structures desi ; Failure and wea	of the developmen oducts, basics of m ed costing; Develo gned for variety; Ba ak-point analysis;	t process. Clarificat anagement of produ pment of environme usics of safety technolo Utilizing Prototypes	tion of the task and act costs by reducing entally safe products, ogy and development s; Development and
2	Learning of On successful 1. Analyse d The students importance. 2. Create a f also able to 3. Describe p for practical 4. Denomina morphologic relevance im 5. Explain th The student 6. Differenti principles of products. 7. Differenti product's life costing and reach. 8. Explain th 9. Analyse of comes from 10. Explain 11. List the measures.	bjectives ul completion of this esign tasks by questions is are also able to trans formal description of differentiate between principles, advantage work. ate and describe the cal analysis and syste innovation projects. The principles of Total is are also able to use the principles of Total is are also able to use the basic wording design to security research the basic wording design to security research the basic wording design to security research the basic wording design to security research to the basic wording design to security research to the basic wording design to security research the basic wording design to security research to the basic wording design to the basic wording de	module, students oning them specifi slate customer's w the design task by a customer's wishe s, and limits of sim approach and the matic combination Quality Manager FMEA as a preven g for development garding their effect es of product cost n should also be able actions to reach the so of creating an er- s regarding the va- of applicability of p- pment and product	should be able to: cally to identify tar ishes into product r y generating a list of es and requirement nultaneous enginee tasks of developing n of solutions, as w nent and their imp nent and their imp nent and their imp nent and their imp trive failure avoida of products design ctiveness for specifie management and kn to analyse cost strue target costs and e cobalance. uriety of products a prototypes. tion in globally acti	rgets and central issu equirements and asso of requirements. The s. ring and explain its r g a new product, usir ell as being able to e lementation and rele nce method. The d to security and esp c tasks and use them howing the basics of the actures using breakey valuate those strateg	es of the design task. ess the requirement's students are relevance and impact ng a xplain their evance in companies. xplain the to develop improved their genesis over the ren-analysis, function gies in regard to their lain the danger that o identify alleviating
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul Written exa Will be anno etc.).	amination m: le exam (Technical ex m (90 min) or oral ex ounced at the beginning	kamination, Oral/ kam (30 min). ng of the term dep	written examinatio pending on the circu	n, Default RS) ımstances (number o	f students, pandemic
5	Prerequisit Passing the	e for the award of c examination	redit points			

6	Grading Module exam: • Module exa	am (Technical examination, Oral/written examination, Weight	ting: 100 %)			
7	Usability of the WP Bachelor MB	Usability of the module WP Bachelor MB				
8	Grade bonus compliant to §25 (2)					
9	 References U. Lindemann. Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden. VDI-Buch. Springer-Verlag Berlin Heidelberg, 2009. G. Pahl;W. Beitz; J. Feldhusen; K.H. Grote. Konstruktionslehre - Grundlagen erfolgreicher Produktentwicklung, Methoden und Anwendungen. Springer Verlag, Berlin, 2006. E. Kirchner & H. Birkhofer. Werkzeuge und Methoden der Produktentwicklung, Vorlesungsunterlagen des pmd, 2018 					
Co	urses					
	Course nr. 16-05-5080-vl	Course name Tools and Methods in Product Development				
	Instructor Type SWS Lecture 2					
	Course nr. 16-05-5080-ue	Course name Tools and Methods in Product Development				
	Instructor Type SWS Practice 2					

3 Interdisciplinary modules of FB 18

Mo Sta	Module name Standardization, Testing and Approvals in the Electrotechnical Area						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18-	gt-4010	3 CP	90 h	60 h	1 Ierm	Summer term	
Ger	i guage man			Module owner Prof. DrIng. Gerd Griepentrog			
1	Teaching co In the Europ tromagnetic implementat These requir in the EU or means of • Own to • Tests c During the I • Produc • Energy • Law or • Teleco • Explos • VDE As for Ele • Standa • O • In • W • Applica • C • C	ontent bean Union (EU), the al compatibility (EM tion in laws and deco rements take shape is , as the case may be, ests or arried out by an inde ecture, these criteria ecture, these criteria ecture, these criteria ecture, these criteria or promotion law (En n electromagnetical or munications law (T ion-protection decre ssociation for Electric ctrical, Electronic & ardization: n national level by En Europe by CENELE forldwide by IEC (= ation of regulation or ase study 1: Function ase Study 2: Protect ase Study 3: Information	e fundamental red AC) including fun- rees. n harmonized sta the user of the ec- ependent neutral f are considered w G) WG) compatibility of ec- rKG) e cal, Electronic and Information Techr DIN and DKE C (= European Co International Elec n the basis of case nal Safety ion against electric ation security	quirements for lect actionality, are stip ndards. The manu quipment has to sho testing laboratory. ith respect to the for quipment (EMVG) Information Techno cologies in DIN and committee of Electro ctrotechnical Comm studies: c shock	rical equipment, suc ulated in EC Directi facturer or his autho ow compliance with ollowing topics: ologies e.V. and DKE l VDE otechnical Standardiz nission).	h as safety and elec- ves and by national rized agent resident the requirements by German Commission ation)	
2	Learning of After complete technical sta will know th	Jectives eting the module stu ndards for research a e basic requirements	dents are aware o Idn development o Is for safety and re	f connections betw f electrotechnical e liability of such pro	een basic requiremen quipment. As an outc oducts.	nts given by law and ome the participants	
3	Recommend	led prerequisites fo	or participation				
4	Form of exa Module exar • Modul	mination n: e exam (Technical ex	xamination, Oral e	examination, Durat	ion: 30 Min., Default	RS)	
5	Prerequisite	e for the award of c	redit points				

	Passing the final	module examination				
6	Grading Module exam: • Module ex	am (Technical examination, Oral examination, Weighting: 100) %)			
7	Usability of the M.Sc. ESE	Usability of the module M.Sc. ESE				
8	Grade bonus compliant to §25 (2)					
9	References					
	 Barz, N., Moritz, D.: EG - Niederspannungsrichtlinie Berlin/Offenbach: vde-verlag, 2008, 230 S. (VDE-Schriftenreihe Band 69) Link für EG-Richtlinien: eur-lex.europa.eu/de/index.htm Moritz, D.: Das Geräte- und Produktsicherheitsgesetz (GPSG) Berlin/Offenbach: vde-verlag, 2004, 138 S. (VDE-Schriftenreihe Band 116) 					
Co	urses					
	Course nr. 18-gt-4010-vl	Course name Standardization, Testing and Approvals in the Electrotechnic	cal Area			
	Instructor DrIng. Stefan H	leusinger	Type Lecture	SWS 2		

Mo Wh	dule name at is Behind A	ll this?						
Mo 18-	dule nr. dg-3002	Credit points 2 CP	Workload 60 h	Self-study 30 h	Module 1 Term	duration	Module cyc Summer ter	cle rm
Lar Ger	iguage man		L	Module owner Prof. DrIng. Her	rbert De G	ersem	1	
1	Teaching co	ntent						
2	Learning ob	Learning objectives						
3	Recommended prerequisites for participation							
4	 Form of examination Module exam: Module exam (Study achievement, Colloquium, p/np RS) 							
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Colloquit	ım, Weighting: 100) %)			
7	Usability of	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Cot	ırses							
	Course nr. 18-dg-3002-1	Course name what is behind	1 all this?					
	Instructor Prof. DrIng.	Herbert De Gersem				Type Colloquit	1m	SWS 2

Mo Wh	dule name at is Behind A	ll this?						
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cyc	cle
Lar	nguage rman		70 11	Module owner Prof. DrIng. Hei	bert De G	ersem	Builliner ter	
1	Teaching co	ntent						
2	Learning ob	jectives						
3	Recommend	Recommended prerequisites for participation						
4	 Form of examination Module exam: Module exam (Study achievement, Special form, Default RS) 							
5	Prerequisite Passing the f	for the award of c	redit points ation					
6	Grading Module exan • Module	n: e exam (Study achie	vement, Special fo	orm, Weighting: 10	0 %)			
7	Usability of	the module						
8	Grade bonu	s compliant to §25	(2)					
9	References							
Co	urses							
	Course nr. 18-dg-3002-1	Course name what is behind	d all this?					
	Instructor Prof. DrIng.	Herbert De Gersem				Type Colloquit	ım	SWS 2

Mo Pate	Module name Patents - How to Protect Technical Inventions					
Mo 18-	dule nr. fi-3010	Credit points 3 CP	Workload 90 h	Self-study 60 h	Module duration 1 Term	Module cycle Summer term
Lar Ger	iguage man			Module owner Prof. DrIng. Rol	f Findeisen	
1	 Teaching content Within the scope of this lecture aspects of national and international patent law as well as aspects of the law on employee will be treated as follows: German, European and international filing procedures and their legal prerequisites (formal and substantive patent law) Enforcement of technical property rights Infringement of technical property rights Law on employee invention - rights and obligations of employees and employers 					
2	2 Learning objectives After completing the module, students will be able to deal with basic patent law issues and will have gained insight into patent law practice.					
3	Recommended prerequisites for participation					
4	Form of exa Module exar • Modul The examina than 5 stude examination	mination n: e exam (Technical ex ation takes place in t nts register, the exan will be announced i	kamination, Oral/ form of a written hination generally n the beginning o	written examinatio exam (duration: 9 will be an oral exa f the lecture.	n, Duration: 90 Min. 0 minutes). If one ca mination (duration: 2	, Default RS) an estimate that less 20 min.). The type of
5	Prerequisite Passing the f	e for the award of c	redit points ation			
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 					
7	Usability of B.Sc. etit	the module				
8	Grade bonu	s compliant to §25	(2)			
9	References					

	 German Pa German internet.de, German L internet.de, European practice/leg Patent Coog Paris Conv www.wipo. 	eent Law "Patentgesetz (PatG)" - www.gesetze-im-internet.de/ Utility Model Act "Gebrauchsmustergesetz (Gb /gebrmg/index.html aw on Employee Invention "Arbeitnehmererfindergesetz /arbnerfg/index.html Patent Convention "Europäisches Patent Übereinkommen gal-texts/epc_de.html peration Treaty (PCT) - www.wipo.int/pct/en/texts/index.htm ention for the Protection of Industrial Property "Pariser V int/treaties/en/ip/paris/	′patg∕index.html mG)" - www.gese (ArbEG)" - www.gese (EPÜ)" - www.epo.o nl ′erbandsübereinkunft (J k:	etze-im- etze-im- rg/law- PVÜ)" -		
	Patent- und Must	errecht; Beck im dtv - ISBN 978-3-406-66154-9				
Co	urses					
	Course nr. 18-fi-3010-vl	Course name Patents - How to protect technical inventions				
	InstructorTypeSWSProf. DrIng. Rolf Findeisen, Dr. Ing. Sebastian CleverLecture2					

4 Modules for other departments

Mo Intr	Module name Introduction into the numerical computation of electromagnetic fields						
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18- Lan Ger	sc-3010 I guage man	5 CP	150 h	75 h Module owner Prof. Dr. rer. nat.	Sebastian Schöps	Winter term	
1	Teaching co Maxwell's e of possible e	ontent quations, basics of nu rrors	imerical calculation	on of electromagnet	ic fields, knowledge a	about different types	
2	2 Learning objectives Starting from basic electromagnetic problems in terms of electric and magnetic circuits the field aspect inherent to these models is discussed. After attending the lecture, the student is capable of modeling given geometric structures and devices using the methods of Computational Engineering. Furthermore, the student is able to solve the related task numerically using appropriate software. The student should understand the basics of the numerical calculation of electromagnetic fields as well as become acquainted with the related procedures in practical applications. The gathered solution methods will be applied practically during the laboratory courses. Moreover basic programming skills related to specific simulation tasks as well as for the purpose of postprocessing the results of the numerical simulations are taught.						
3	Recommend Elektrotechn	ded prerequisites fo nik und Informations	r participation technik I und II				
4	Form of exa Module exar • Module The examina 30 students will be anno	mination n: e exam (Technical ex ition takes place in fo register, the examina unced in the beginni	amination, Oral/ rm of a written ex tion will be an ora ng of the lecture.	written examinatio am (duration: 90 m al examination (dur	n, Duration: 90 Min. ninutes). If one can es ration: 25 min.). The	, Default RS) stimate that less than type of examination	
5	Prerequisite Passing the f	e for the award of c	redit points ation				
6	 Grading Module exam: Module exam (Technical examination, Oral/written examination, Weighting: 100 %) 						
7	Usability of B.Sc. etit, B.	the module Sc. CE, B.Sc. WI-etit					
8	Grade bonu yes	s compliant to §25	(2)				
9	 References Will be handed out during the lecture and is provided via Moodle 						
Coι	irses						

	Course nr.Course name18-sc-3010-vlIntroduction into the numerical computation of electromagnetic fields				
InstructorTypeM.Sc. Melina Merkel, Prof. Dr. rer. nat. Sebastian SchöpsLecture					
	Course nr. 18-sc-3010-ue	Course name Introduction into the numerical computation of electromagne	etic fields		
	Type Project seminar	SWS 3			

Mo	dule name					
Inti	roduction to E	Electrical Engineering				1
Mo	dule nr. kn-3010	Credit points 6 CP	Workload 180 h	Self-study 90 h	Module duration	Module cycle
Lar Ger	nguage man	0.01	100 11	Module owner Prof. Dr. Mario K	upnik	
1	1 Teaching content Basic physical quantities, fundamental forces, stationary charges - electrostatics, Coulomb's law, superposition, electrical field, electric flow, Gauss' law, area charge density, electrical potential and difference of potential, capacitor and term capacity, charging process, polarization, moving charge - electric flux field, drift velocity, electrical current, Ohm's law, elektrical power, voltage- and current source, battery, power matching, efficiency ratio, Kirchhoff law, linear DC circuits, term magnetism, magentic field, magnetic flux, electromagnet, electrodynamic principle - Lorentzforce, electric motor, solenoid and term inductance, Biot-Savart and Ampere's law, magentization, magnetic excitation and magnetic flux density, matter in magnetic field and explanation of hesterysis curve, Lenz's law, Faraday's law, generator principle, harmonic functions, basics alternating current quantities, pointer diagrams, basic elements and power in alternating current circuits, term of impedance, transient events in RC- and RL-elements, ODE of first order, complex variable domain, transformer, three-phase current, resonant circuits and mechanical analogy, two and four-port elements, measurement amplifiers, electrical lines and electromagnetic wave.					
2	 Learning objectives On successful completion of this module, students should be able to: comprehend and analyze electric and magnetic fields, as well as the electric flux field, utilize Maxwell's equations in integral form for this, calculate currents and voltages in DC and AC circuits, use complex numbers for electrical engineering, calculate transient switching events, comprehend and know the underlying principles of electrical machines (motor, generator, transformer), comprehend the basics of resonant circuits, measurement amplifiers and closed loop systems, know the mechanism behind energy- and information transfer via electric lines and electromagnetic waves. 					
3	Recomment Recomment	ded prerequisites fo led: Mathematics I	or participation			
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	150 Min., Default RS	3)
5	Prerequisite Passing the	e for the award of cr final module examina	redit points ation			
6	Grading Module exa • Modul	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. Bio-M	the module aterials Engineering				
8	Grade bonu	is compliant to §25	(2)			
9	References					

Lecture notes

- Vorlesungsfolien mit Abbildungen zum Download und Mitschreiben in Vorlesung über Lehrplattform,
- Aufzeichnungen (Bild und Ton) von Visualizer über Lehrplattform nach jeder Vorlesung,
- Vorlesungsfolien mit handschriftlichen Ergänzungen und Skizzen des Dozenten zum Download über Lehrplattform nach jeweiliger Vorlesung,
- Giancoli, Douglas C.: Physik Lehr- und Übungsbuch, Kapitel 21-32., 3. erweiterte Auflage, Pearson Studium Verlag, 2010 (Primärliteratur, relevanter Auszug < 15% nach UrhG Par 60a Abs. 1 vom 01.03.2018 wird zum Download über Lehrplattform nur für eingeschriebene Studierende bereitgestellt).
- Purcell, Edward M.: Elektrizität und Magnetismus, 4. Auflage, Vieweg Verlag, 1989 (vertiefend).
- Bergmann, Schaefer.: Lehrbuch der Experimentalphysik Elektromagnetismus, Band 2, 9. Auflage, de Gruyter Verlag, 2006 (vertiefend)

Courses

00	Juises					
	Course nr. 18-kn-3010-vl	Course name Introduction to Electrical Engineering				
	Instructor Prof. Dr. Mario Kupnik		Type Lecture	SWS 4		
	Course nr. 18-kn-3010-ue	Course name Introduction to Electrical Engineering				
	Instructor Prof. Dr. Mario K	upnik, M.Sc. Felix Herbst, M.Sc. Sonja Wismath	Type Practice	SWS 2		
Mo	dule name					
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Inti	roduction to E	Electrical Engineering				1
Mo	dule nr. kn-3011	Credit points 6 CP	Workload 180 h	Self-study 90 h	Module duration	Module cycle
Lar Ger	nguage man	0.01	100 11	Module owner Prof. Dr. Mario K	upnik	
1	1Teaching contentBasic physical quantities, fundamental forces, stationary charges - electrostatics, Coulomb's law, superposition, electrical field, electric flow, Gauss' law, area charge density, electrical potential and difference of potential, capacitor and term capacity, charging process, polarization, moving charge - electric flux field, drift velocity, elec- trical current, Ohm's law, elektrical power, voltage- and current source, battery, power matching, efficiency ratio, Kirchhoff law, linear DC circuits, term magnetism, magentic field, magnetic flux, electromagnet, electrodynamic principle - Lorentzforce, electric motor, solenoid and term inductance, Biot-Savart and Ampere's law, magenti- zation, magnetic excitation and magnetic flux density, matter in magnetic field and explanation of hesterysis curve, Lenz's law, Faraday's law, generator principle, harmonic functions, basics alternating current quantities, pointer diagrams, basic elements and power in alternating current circuits, term of impedance, transient events in RC- and RL-elements, ODE of first order, complex variable domain, transformer, three-phase current, resonant circuits and mechanical analogy, two and four-port elements, measurement amplifiers, electrical lines and electromagnetic wave.					
2	 2 Learning objectives On successful completion of this module, students should be able to: comprehend and analyze electric and magnetic fields, as well as the electric flux field, utilize Maxwell's equations in integral form for this, calculate currents and voltages in DC and AC circuits, use complex numbers for electrical engineering, calculate transient switching events, comprehend and know the underlying principles of electrical machines (motor, generator, transformer), comprehend the basics of resonant circuits, measurement amplifiers and closed loop systems, know the mechanism behind energy- and information transfer via electric lines and electromagnetic waves. 					d, erator, transformer), o systems, ectromagnetic waves.
3	Recomment Recomment	ded prerequisites fo led: Mathematics I	or participation			
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	xamination, Exam	ination, Duration:	150 Min., Default RS	5)
5	Prerequisit Passing the	e for the award of cr final module examina	redit points ation			
6	Grading Module exame • Module	m: le exam (Technical ex	xamination, Exam	ination, Weighting	: 100 %)	
7	Usability of B.Sc. Mater	the module ialwissenschaften				
8	Grade bonu	is compliant to §25	(2)			
9	References					

Lecture notes

- Vorlesungsfolien mit Abbildungen zum Download und Mitschreiben in Vorlesung über Lehrplattform,
- Aufzeichnungen (Bild und Ton) von Visualizer über Lehrplattform nach jeder Vorlesung,
- Vorlesungsfolien mit handschriftlichen Ergänzungen und Skizzen des Dozenten zum Download über Lehrplattform nach jeweiliger Vorlesung,
- Giancoli, Douglas C.: Physik Lehr- und Übungsbuch, Kapitel 21-32., 3. erweiterte Auflage, Pearson Studium Verlag, 2010 (Primärliteratur, relevanter Auszug < 15% nach UrhG Par 60a Abs. 1 vom 01.03.2018 wird zum Download über Lehrplattform nur für eingeschriebene Studierende bereitgestellt).
- Purcell, Edward M.: Elektrizität und Magnetismus, 4. Auflage, Vieweg Verlag, 1989 (vertiefend).
- Bergmann, Schaefer.: Lehrbuch der Experimentalphysik Elektromagnetismus, Band 2, 9. Auflage, de Gruyter Verlag, 2006 (vertiefend)

Courses

00	urses			
	Course nr. 18-kn-3010-vl	Course name Introduction to Electrical Engineering		
	Instructor Prof. Dr. Mario Kupnik		Type Lecture	SWS 4
	Course nr. 18-kn-3010-ue	Course name Introduction to Electrical Engineering		
InstructorTypeProf. Dr. Mario Kupnik, M.Sc. Felix Herbst, M.Sc. Sonja WismathPractice				

Mo Inti	dule name roduction to E	Electrical Engineering	g for BEd			
Mo 18-	dule nr. kn-3012	Credit points 3 CP	Workload 90 h	Self-study 0 h	Module duration 1 Term	Module cycle Summer term
Lar Ger	nguage man	1		Module owner Prof. Dr. Mario K	upnik	1
1	Teaching content Basic physical quantities, fundamental forces, stationary charges - electrostatics, Coulomb's law, superposition, electrical field, electric flow, Gauss' law, area charge density, electrical potential and difference of potential, capacitor and term capacity, charging process, polarization, moving charge - electric flux field, drift velocity, electrical current, Ohm's law, elektrical power, voltage- and current source, battery, power matching, efficiency ratio, Kirchhoff law, linear DC circuits, term magnetism, magentic field, magnetic flux, electromagnet, electrodynamic principle - Lorentzforce, electric motor, solenoid and term inductance, Biot-Savart and Ampere's law, magentization, magnetic excitation and magnetic flux density, matter in magnetic field and explanation of hesterysis curve, Lenz's law, Faraday's law, generator principle, harmonic functions, basics alternating current quantities, pointer diagrams, basic elements and power in alternating current circuits, term of impedance, transient events in RC- and RL-elements, ODE of first order, complex variable domain, transformer, three-phase current, resonant circuits and mechanical analogy, two and four-port elements, measurement amplifiers, electrical lines and electromagnetic wave.					
2	 2 Learning objectives On successful completion of this module, students should be able to: comprehend and analyze electric and magnetic fields, as well as the electric flux field, utilize Maxwell's equations in integral form for this, calculate currents and voltages in DC and AC circuits, use complex numbers for electrical engineering, calculate transient switching events, comprehend and know the underlying principles of electrical machines (motor, generator, transformer), comprehend the basics of resonant circuits, measurement amplifiers and closed loop systems, know the mechanism behind energy- and information transfer via electric lines and electromagnetic waves 					d, erator, transformer), o systems, ectromagnetic waves.
3	Recomment	ded prerequisites fo led: Mathematics I	or participation			
4	Form of exa Module exa • Modul	amination m: le exam (Technical e:	xamination, Exam	ination, Duration:	150 Min., Default RS	3)
5	Prerequisit Passing the	e for the award of c final module examination	redit points ation			
6	GradingModule exam:Module exam (Technical examination, Examination, Weighting: 100 %)					
7	Usability of	f the module				
8	Grade bonu	is compliant to §25	(2)			
9	References					

Lecture notes

- Vorlesungsfolien mit Abbildungen zum Download und Mitschreiben in Vorlesung über Lehrplattform,
- Aufzeichnungen (Bild und Ton) von Visualizer über Lehrplattform nach jeder Vorlesung,
- Vorlesungsfolien mit handschriftlichen Ergänzungen und Skizzen des Dozenten zum Download über Lehrplattform nach jeweiliger Vorlesung,
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- Purcell, Edward M.: Elektrizität und Magnetismus, 4. Auflage, Vieweg Verlag, 1989 (vertiefend).
- Bergmann, Schaefer.: Lehrbuch der Experimentalphysik Elektromagnetismus, Band 2, 9. Auflage, de Gruyter Verlag, 2006 (vertiefend)

Courses

CO	urses			
	Course nr. 18-kn-3010-vl	Course name Introduction to Electrical Engineering		
InstructorTypeProf. Dr. Mario KupnikLecture				SWS 4
	Course nr. 18-kn-3010-ue	Course name Introduction to Electrical Engineering		
InstructorTypeProf. Dr. Mario Kupnik, M.Sc. Felix Herbst, M.Sc. Sonja WismathPractice				

Mo	dule name					
Арг	olied Comput	ational Modeling and	l Analysis			1
Mo	dule nr. kp-3020	Credit points 6 CP	Workload 180 h	Self-study 90 h	Module duration	Module cycle Winter term
Lar Eng	i guage glish			Module owner Prof. Dr. techn. H	leinz Köppl	
1	1 Teaching content The module provides an introduction to modeling and analysis approaches relevant to synthetic biology. It builds on the mathematical basis provided in the module "mathematical foundations of modeling and analysis". Apart from short introductory lectures, practical programming of respective algorithms will be the main modality to learn the subject. The course covers purely data-driven methods from biostatistics and machine learning but also first-principle modeling approaches from biophysics and biochemistry. Concrete scientific problem statements will used to learn about the modeling and analysis algorithms. Introduction to scientific programming using Julia Introduction to biostatistics, bioinformatics and machine learning Deterministic and stochastic approaches for modeling reaction networks Thermodynamic analysis of reactions networks Principles of molecular dynamics, structure prediction Numerical solution and simulation methods					
2	 Learning objectives Students gained an overview of relevant computational approaches in the area of synthetic biology. They can categorize approaches and find dedicated literature for an in-depth coverage. They are able to understand new modeling and analysis algorithms and are able to implement them on their own in a programming language of choice. They know how to practically handle real experimental data, analyze the data and utilize data with a modeling project. 					
3	Recommen Passing of m	ded prerequisites fo nodule "Basics in Synt	or participation thetic Biology"			
4	Form of exa Module exa • Modul	amination m: le exam (Technical ex	amination, Prese	ntation, Default RS)	
5	Prerequisit Passing the on a scientif a team.	e for the award of cr exams. Compulsory a ic problem in a team.	redit points ittendance in 75% For this purpose,	of the seminar. A f it is necessary that	ocus of the module is the team members sp	s on making progress bend time together as
6	Grading Module exa • Modul	m: le exam (Technical ex	amination, Prese	ntation, Weighting	: 100 %)	
7	Usability of M.Sc. Synth	the module etic Biology				
8	Grade bonu	is compliant to §25	(2)			
9	References					

- Neil Jones & Pavel Pevzner. An Introduction to bioinformatics algorithms, MIT Press, 2004
- Daniel Beard & Hing Qian. Chemical Biophysics, Cambridge University Press, 2010
- Darren Wilkinson. Stochastic modeling for systems biology, CRC Press, 2006
 Kevin P. Murphy. Machine Learning A probabilistic perspective, MIT Press, 2012

C

CO	urses			
	Course nr. 18-kp-3020-vl	Course name Applied computational modeling and analysis		
InstructorTypeProf. Dr. techn. Heinz KöpplLecture				SWS 1
	Course nr. 18-kp-3020-se	Course name Applied computational modeling and analysis		
	Instructor Prof. Dr. techn. H	leinz Köppl	Type Seminar	SWS 5

Mo	dule name	Electrical Engineeri	no and Power Svet	ems				
Mo	dule nr.	Credit points	Workload	Self-study	Module	duration	Module cy	cle
Lar	iguage	5.01	150 11	Module owner Prof. Dr. rer. nat.	Florian St	einke	whiter term	
1	Teaching co	ontent		I				
	 Direct current circuits: Ohm's law, Kirchhoff's theorems Alternating current circuits: dynamic behavior of coils and capacitors, computation via phasors and complex-valued impedances, active and reactive power Electro-magnetic fields: source and vortex fields, Coulomb's law, electrical displacement density, influence, magnetic fields, induction, Maxwell's laws in integral form Elements of power engineering: three phase systems, transformators, electrical machines, power electronics and power converters Introduction into current research topics in power engineering 							
2	2 Learning objectives After the course, students are able to name the electric variables and components, to calculate the electric direct- and alternating current circuits, and to derive electric and magnetic fields in simple, quasi-stationary settings. Moreover, they know the working principles of important power system components.							
3	Recommen Basic mathe differential	ded prerequisites for matics: working with equations	or participation n complex number	rs, matrices / vecto	rs / system	ns of linear	r equations, o	ordinary
4	Form of exa Module exa • Modul The examin less than 7 examination	amination m: le exam (Technical ex ation takes place in students register, the n will be announced i	kamination, Oral/ form of a writter e examination wil in the beginning o	written examinatio 1 exam (duration: 1 be an oral exami f the lecture.	n, Duratio 120 minu nation (du	n: 120 Min Ites). If or Iration: 25	n., Default RS ne can estima 5 min.). The	5) ate that type of
5	Prerequisit Passing the	e for the award of c final module examination	redit points ation					
6	Grading Module exa • Modu	m: le exam (Technical ez	kamination, Oral/ [,]	written examinatio	n, Weighti	ing: 100 %	b)	
7	Usability of M.Sc. ESE,	the module M.Sc. CE, B.Sc. CE						
8	Grade bonu	is compliant to §25	(2)					
9	9 References A lecture script and slides are provided via Moodle.							
Cot	ırses							
	Course nr. 18-st-3020-	vl Fundamentals	of Electrical Engi	neering and Power	Systems			
	Instructor Prof. Dr. r laeivaneghi,	er. nat. Florian Ste Prof. DrIng. Gerd (einke, M.Sc. Ade Griepentrog	el Jamal, M.Sc. S	ara Mol-	Type Lecture		SWS 3

Course nr. 18-st-3020-ue	Course name Fundamentals of Electrical Engineering and Power Systems		
Instructor Prof. Dr. rer. r laeivaneghi, Prof	at. Florian Steinke, M.Sc. Adeel Jamal, M.Sc. Sara Mol- DrIng. Gerd Griepentrog	Type Practice	SWS 1

Final Modules

Mo Bac	dule name chelorthesis					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	00-4000	12 CP	360 h	360 h	1 Term	Every Semester
Ger	man/English			Module owner		
1	1 Teaching content Students independently prepare a written paper on a scientific question, taking into account relevant scientific articles and specialist literature. The Bachelor thesis is written in a limited amount of time and takes into account the principles of scientific work. Further general conditions are specified by the offering department when the task is assigned.					
2	 2 Learning objectives After completion of the module, students are able to, work independently on a scientific problem according to scientific principles. apply the knowledge, methods and competences acquired in the Bachelor's program. to research, narrow down and evaluate the relevant literature. to systematize the topic in a meaningful way and to build up a line of argument. weigh the validity of pro and contra arguments in a comprehensible way. to set down the results in writing according to scientific criteria. represent the results in an argumentative manner. 					
3	Recomment	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul • Modul Final examin	mination n: e exam (Technical ex e exam (Technical ex nation consisting of t	xamination, Writte xamination, Colloc he preparation of	en examination, De quium, Duration: 3 a thesis	fault RS) 0 Min., Default RS)	
5	Prerequisite Passing the	e for the award of c r final module examina	redit points ation			
6	 6 Grading Module exam: Module exam (Technical examination, Written examination, Weighting: 80 %) Module exam (Technical examination, Colloquium, Weighting: 20 %) 					
7	Usability of B.Sc. etit, B.	the module Sc. MEC, B.Sc. Med	Tec, B.Sc. iST			
8	Grade bonu	s compliant to §25	(2)			
9	References					

Topic-dependent research literature as introductory reading in German and English, which can be supplemented independently in a meaningful way.

Courses

Mo	dule name					
Mo	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	00-5000	30 CP	900 h	900 h	1 Term	Every Semester
Lan Ger	nguage man/English			Module owner		
1	 I leaching content Students independently prepare a written paper on a scientific question, taking into account relevant scientific articles and specialist literature. The Bachelor thesis is written in a limited amount of time and takes into account the principles of scientific work. Further general conditions are specified by the offering department when the task is assigned. Learning content 					
2	 2 Learning objectives After completion of the module, students are able to, work independently on a scientific problem according to scientific principles. apply the knowledge, methods and competences acquired in the Master's program. to research, narrow down and evaluate the relevant literature. to systematize the topic in a meaningful way and to build up a line of argument. weigh the validity of pro and contra arguments in a comprehensible way. to set down the results in writing according to scientific criteria. represent the results in an argumentative manner. 					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modu • Modu Final exami	amination m: le exam (Technical ex le exam (Technical ex nation consisting of t	xamination, Colloc xamination, Writte he preparation of	quium, Duration: 3 en examination, De a thesis	0 Min., Default RS) fault RS)	
5	Prerequisit Passing the	e for the award of c final module examina	redit points ation			
6	 6 Grading Module exam: Module exam (Technical examination, Colloquium, Weighting: 20 %) Module exam (Technical examination, Written examination, Weighting: 80 %) 					
7	Usability of M.Sc. etit, M	f the module M.Sc. MEC, M.Sc. Me	dTec, M.Sc. iST			
8	Grade bonus compliant to §25 (2)					
9	 References Topic-dependent research literature as introductory reading in German and English, which can be supplemented independently in a meaningful way. 					
Co ι	urses					

Мо	dule name						
Mas	sterthesis iCE						
	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle	
18	20-5000	30 CP	900 h	900 II I Term Every Semester			
Eng	i guage rlish			Module owner			
1	Teaching co Students inc articles and the principle task is assig	ontent lependently prepare specialist literature. T es of scientific work. ned.	a written paper of The Bachelor thesis Further general co	n a scientific questi s is written in a limi onditions are specif	on, taking into accou ted amount of time a fied by the offering d	int relevant scientific nd takes into account epartment when the	
2	 2 Learning objectives After completion of the module, students are able to, work independently on a scientific problem according to scientific principles. apply the knowledge, methods and competences acquired in the Master's program. to research, narrow down and evaluate the relevant literature. to systematize the topic in a meaningful way and to build up a line of argument. weigh the validity of pro and contra arguments in a comprehensible way. to set down the results in writing according to scientific criteria. represent the results in an argumentative manner. 						
3	Recommen	ded prerequisites fo	or participation				
4	Form of exa Module exa • Modul • Modul Final examin	amination m: e exam (Technical ex e exam (Technical ex nation consisting of t	amination, Colloc amination, Writte he preparation of	quium, Duration: 3 en examination, De a thesis	0 Min., Default RS) fault RS)		
5	Prerequisite Passing the	e for the award of c	redit points ation				
6	 6 Grading Module exam: Module exam (Technical examination, Colloquium, Weighting: 20 %) Module exam (Technical examination, Written examination, Weighting: 80 %) 						
7	Usability of	the module					
8	Grade bonu	is compliant to §25	(2)				
9	References Topic-depen independen	dent research literatu tly in a meaningful w	ire as introductory 7ay.	reading in Germar	and English, which o	can be supplemented	
COL	irses						

Mo Ma	dule name sterthesis ESF					
Мо	dule nr.	Credit points	Workload	Self-study	Module duration	Module cycle
18-	70-5010	30 CP	900 h	900 h	1 Term	Every Semester
Lar Ger	nguage man/English			Module owner Prof. DrIng. Ger	d Griepentrog	
1	1 Teaching content Students independently prepare a written paper on a scientific question, taking into account relevant scientific articles and specialist literature. The Master thesis is written in a limited amount of time and takes into account the principles of scientific work. Further general conditions are specified by the offering department when the task is assigned.					
2	 2 Learning objectives After completion of the module, students are able to, work independently on a scientific problem according to scientific principles. apply the knowledge, methods and competences acquired in the Master's program. to research, narrow down and evaluate the relevant literature. to systematize the topic in a meaningful way and to build up a line of argument. weigh the validity of pro and contra arguments in a comprehensible way. to set down the results in writing according to scientific criteria. represent the results in an argumentative manner. 					
3	Recommen	ded prerequisites fo	or participation			
4	Form of exa Module exa • Modul • Modul Final examin	mination n: e exam (Technical ex e exam (Technical ex nation consisting of t	xamination, Colloo xamination, Writte he preparation of	quium, Duration: 3 en examination, De a thesis	0 Min., Default RS) fault RS)	
5	Prerequisit Passing the	e for the award of c	redit points ation			
6	 5 Grading Module exam: Module exam (Technical examination, Colloquium, Weighting: 20 %) Module exam (Technical examination, Written examination, Weighting: 80 %) 					
7	Usability of	the module				
8	Grade bonu	is compliant to §25	(2)			
9	References Topic-depen independen	dent research literatu tly in a meaningful w	ıre as introductory vay.	reading in German	and English, which o	can be supplemented
Coi	ırses					