HAW HAMBURG

Modulhandbuch des Bachelor-Studiengangs Information Engineering (IE)

Stand: StPO 2016

Name of module	**Mathematics 1**	Abbreviation	MA1/MAE1
Courses	Lecture: Mathematics 1 Exercises: Mathematics 1	Semester/ duration	1
Workload	108h attendance, 132h self-study	Credits	8
Module responsibility	Prof. Dr. Heß	Hours per week	5+1
Lecturers	Prof. Dr. Hess, Prof. Dr. Jünemann, Prof. Dr. Klinker, Prof. Dr. Landenfeld	Language	English
Prerequisites	School mathematics	offered	Academic year
Learning outcomes	The students • are able to understand the concept of logic, sets, functions and boolean algebra, • are able to calculate with natural, integer, rational, real and complex numbers, • can perform proofs by mathematical induction, • can handle sequences and series – their limits and region of convergence, • understand the exponential function with complex arguments, its properties and its relation to trigonometric functions, • can work with single argument functions, their inversion, composition and limits, • understand the concept of Continuity and Differentation, • are able to mastery of differentiation rules • can handle polynomials and the Taylor polynomial of a given function, • are able to compute the partial fraction decomposition of rational functions, • are able to compute local maxima and minima of functions, • can solve systems of linear equations and study its properties, • can handle matrices in the context of systems of linear equations, • can perform Gauss-Jordan elimination, • can handle matrices as linear maps and understand linear independence, • are able to evaluate the determinant of matrices and understand their meaning in geometry and for systems of linear equations.		
Learning content	• This unit presents and introduction to the fundamentals of Differential Calculus for single argument functions and to linear algebra. Many applications and solution techniques are presented		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Exercises: Practical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Exercises: Successful participation in exercises (PVL)		
Literature	• Lecture notes • Courant, R.; John, F. (1998) Introduction to Calculus and Analysis, Springer • Murray, H.; Protter. (1998): Basic Elements of Real Analysis, Springer		

Name of module	**Software Construction 1**	Abbreviation	SO1/SOL1
Courses	Lecture: Software Construction 1 Laboratory: Software Construction 1	Semester/ duration	1
Workload	99h attendance, 111h self-study	Credits	7
Module responsibility	Prof. Dr. Sauvagerd	Hours per week	4+1,5
Lecturers	Prof. Dr. Hotop, Prof. Dr. Klinker, Prof. Dr. Landenfeld, Prof. Dr. Lange, Prof. Dr. Sauvagerd	Language	English
Prerequisites	Basics of mathematics, basics of computers: editor, WORD	offered	Academic year
Learning outcomes	The students • understand C syntax and can write an ANSI C program, • can construct ANSI C software for small applications, • are able to work with an IDE (integrated development environment), • are able to write medium-complex programs in ANSI C, • are able to implement recursive and iterative programming techniques in ANSI C, • can set up a suitable test-bench, • are able to apply suitable verification techniques and debug ANSI C programs.		

Learning content	**Lecture:**
	• This module introduces into programming in ANSI C. The programming environment and the fundamental programming structures in ANSI C are described
	• During the lecture, the basic usage of
	  • data types, input and output,
	  • control structures,
	  • functions,
	  • arrays,
	  • pointers,
	  • structures,
	  • dynamic memory handling,
	  • file I/O
	are discussed in detail. An Introduction into an IDE tool is also given
	Laboratory:
	• During the laboratories transferring of main features of ANSI C syntax into applications is trained. Main focus is on the implementation of medium-complexity ANSI C programs using functions, arrays/pointers and structures with or without dynamic memory allocation		

Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in the lab-courses with written reports and a final examination (PVL)		
Literature	• Prata, S. (2004): C Primer Plus, Sams • Darnell, P. (1996): C, A software engineering approach, Springer • Kernighan, B.; Ritchie, D. (1988): The C programming language, Prentice Hall • Deitel, P.; Deitel, H. (2012): C How to program, Prentice Hall		

Name of module	**Electrical Engineering 1**	Abbreviation	EE1/EEL1
Courses	Lecture: Introduction to Electrical Engineering 1 Laboratory: Introduction to Electrical Engineering 1	Semester/ duration	1
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Rettig	Hours per week	3+1
Lecturers	Prof. Dr. Rettig, Prof. Dr. Lehmann, Prof. Dr. Dahlkemper	Language	English
Prerequisites	Knowledge of calculus (incl. curve sketching, quadratic equations, differential and integral calculus)	offered	Academic year
Learning outcomes	The students • are able to measure and calculate voltage and current in basic DC networks with linear and non-linear components, • are able to measure and calculate voltage and current in basic AC networks with capacitors/inductors and sinusoidal excitation, • are able perform and evaluate measurements in both DC and AC systems.		
Learning content	• **Fundamental Concepts:** Physical basis of voltage, current, power, energy, Ohm's law, Kirchhoff's laws, superposition principle, mesh and nodal analysis, Thevenin's and Norton's theorems, equivalent voltage and current sources • **DC:** Instruments for DC measurements, error calculation and propagation, DC bridge circuits • **AC:** Characterization of AC-signals, Phasors, impedance, reactance, admittance, AC bridge circuits, AC power, power factor correction, frequency- and amplitude-response, filters, resonant circuits • **Components:** Resistors, non-linear resistors, linear sources, controlled sources, inductors, capacitors • **Tools:** DC-measurement of voltage, current and resistance, instrumentation, errors and tolerances in instruments, simulations		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in 2 measurement labs and 2 computer simulation lab-courses with written reports (PVL)		
Literature	• Bongart, T. (1992): Electric Circuits, McGraw-Hill • Edminister, J. (2011): Schaum's Outline of Electric Circuits, McGraw-Hill Professional • Boylestad, R. (2010): Introductory Circuit Analysis, Prentice Hall • Alexander, C.K. (2012): Fundamentals of Electric Circuits, McGraw-Hill		

Name of module	**German**	Abbreviation	GE
Courses	Lecture: German	Semester/ duration	1
Workload	36h attendance, 84h self-study	Credits	4
Module responsibility	Prof. Dr. Leutelt	Hours per week	2
Lecturers	External lecturers	Language	German
Prerequisites	All levels accepted – different courses available	offered	Academic year
Learning outcomes	The students • have improved the ability to communicate in German to assist in their daily interaction with their surroundings, but also to express themselves efficiently and competently in their course studies, • are better prepared to participate in technical discussions for the purpose of an internship or a career in a German company, • have used authentic teaching material which improved their speaking, writing, reading and understanding abilities, • have acquired grammatical proficiency and broadened their understanding of the German culture, • have trained their optimization of presentations.		
Learning content	• German language classes are offered on different levels, for example elementary (A1), pre-intermediate (A2-B1), intermediate (B2), or upper intermediate (C1-C2) according to CEFR (Common European Framework of Reference for Languages) • Grammar, syntax, vocabulary and practical speech training for daily professional and technical situations • Analysis, presentation and documentation (description) of technical and daily situations in German • an excursion to one of the major companies like AIRBUS, which is a linguistic as well as technical challenge, upon which we will later reflect and comment on		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, work sheets, hand outs, computer simulation, DVD		
Type of Assessment	Lecture: Successful passing in oral and written assignments/examinations at regular intervals during the semester and final written exam or paper (SL)		
Literature	• List of work- and reference books will be provided, Internet Links, Bilingual Dictionary, Hand outs		

Name of module	**Learning and study methods (1)**	Abbreviation	LSE1/LSL1
Courses	Lecture: Learning and study methods (1) Coaching project: Coaching	Semester/ duration	1
Workload	58h attendance, 62h self-study	Credits	4
Module responsibility	Prof. Dr. Leutelt	Hours per week	2+1,5
Lecturers	External lecturers	Language	English
Prerequisites	None: Introductory course	offered	Academic year
Learning outcomes	The students • can use methodical and organizational tools and are able to complete the course assignments and examinations punctually, effectively and independently using the English language. In order to do this, skills outside of the technical subject area have been presented and subsequently acquired by the students, • are aware of their personal work and learning techniques with regard to life-long learning strategies and goals, • are able to solve problems and complete tasks systematically as well as analyse complex daily situations and set personal goals, • are able to self-reflect their individual learning progress by the collateral coaching project that is continued in semester 2.		
Learning content	• Time management • Learning and studying techniques (independent study) • Group work/ Teamwork/ Group projects • Reading skills • Scientific/ academic methods • Presentation skills • Dealing with stress • Motivation • Responsibility		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation		
Type of Assessment	Lecture: Successful passing in oral presentation, oral examination and referat (SL)		
Literature	• Jewler, A.; Gardner, J. (1993): Your College Experience: Strategies for Success, Wadsworth • Gardner, J.; Upcraft, M.L. (2004): Challenging and Supporting the First-Year Student: A Handbook for Improving the First Year of College, Jossey-Bass • Powell, M. (1996): Presenting in English: How to Give Successful Presentations, Language Teaching Publications		

Name of module	**Mathematics 2**	Abbreviation	MA2/MAE2
Courses	Lecture: Mathematics 2 Exercises: Mathematics 2	Semester/ duration	2
Workload	108h attendance, 132h self-study	Credits	8
Module responsibility	Prof. Dr. Heß	Hours per week	5+1
Lecturers	Prof. Dr. Hess, Prof. Dr. Jünemann, Prof. Dr. Klinker, Prof. Dr. Landenfeld	Language	English
Prerequisites	Course in Mathematics 1	offered	Academic year
Learning outcomes	The students • can handle primitive functions and definite/indefinite integrals, • can apply integral calculus to questins of geometry, physics and enginieering, • are able to integrate single argument functions by different integration techniques, • can apply partial fraction decomposition to integrate rational functions, • can handle multiple argument and multiple value functions, • understand necessary conditions for local extrema of multiple argument functions, • are able to recognize certain types of ordinary differential equations (ODEs) and apply solution methods, • can compute the solution of linear ODEs with constant coefficients and source terms, • can handle rules for expectation value and variance of random variables, • can analyze various discrete and continuous distributions, • are able to evaluate covariance and correlation coefficient of random variables, • can apply the law of large numbers and the central limit theorem.		
Learning content	• This unit presents and introduction to the fundamentals of integral calculus, multiple argument functions, differential equations and statistics. Many applications and solution techniques are presented.		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Exercises: Practical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Exercises: Successful participation in exercises (PVL)		
Literature	• Lecture notes • Courant, R.; John, F. (1998) Introduction to Calculus and Analysis, Springer • Murray, H.; Protter. (1998): Basic Elements of Real Analysis, Springer		

Name of module	**Software Construction 2**	Abbreviation	SO2/SOL2
Courses	Lecture: Software Construction 2 Laboratory: Software Construction 2	Semester/ duration	2
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Hotop	Hours per week	3+1
Lecturers	Prof. Dr. Dierks, Prof. Dr. Hotop, Prof. Dr. Lehmann, Prof. Dr. Sauvagerd	Language	English
Prerequisites	Knowledge and ability of module Software Construction 1	offered	Academic year
Learning outcomes	The students • understand JAVA syntax and can write a JAVA program, • can construct classes in object oriented form using the JAVA API, • are able to design and test JAVA programs inside a development tool, • are able to use encapsulation and inheritage structures, • can use packages, streams, file handling, threads, swing and other parts of the basic JAVA API, • can construct JAVA software including a graphical user interface for small applications.		
Learning content	**Lecture:** • Introduction into the object oriented programming in JAVA • The Programming environment and the fundamental programming structures in JAVA • The object oriented programming fundamentals • The basic usage of classes, associations, inheritance, encapsulation and other object oriented subjects • Main libraries of the API (Application Programming Interface) • The execution of JAVA programs using graphical user interfaces and threads **Laboratory:** • During the laboratories the transferring of the main parts of the object oriented JAVA syntax into applications has to be trained. The implementation of JAVA programs, the usage of JAVA classes and the usage of the JAVA software Developers Kit (SDK) is the main focus of this module.		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in the lab-courses with written reports and a final examination (PVL)		
Literature	• Haines, S.; Potts, S. (2002): Java 2 Primer Plus, SAMS Publishing • Flanagan, D. (2005): JAVA in a Nutshell, A Desktop Quick Reference, O'Reilly • Horstmann, C.S.; Cornell, G. (2003): Core Java 2, Volume I-Fundamentals, Sun Microsystems Press • Esser, F. (2001): Java 2, Designmuster und Zertifizierungswissen, Galileo Press • Eckel, B. (2006): Thinking in Java, Prentice Hall • Arnold, K.; Gosling, J.; Holmes, D. (2001): The Java Programming Language Third Edition, Addison-Wesley		

Name of module	**Electrical Engineering 1**	Abbreviation	EE2/EEL2
Courses	Lecture: Introduction to Electrical Engineering 2 Laboratory: Introduction to Electrical Engineering 2	Semester/ duration	2
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Rettig	Hours per week	3+1
Lecturers	Prof. Dr. Rettig, Prof. Dr. Lehmann, Prof. Dr. Dahlkemper	Language	English
Prerequisites	Bachelor Course Information Engineering: Introduction into Electrical Engineering 1	offered	Academic year
Learning outcomes	The students • have the ability to measure and calculate voltage and current in advanced AC networks with capacitors/inductors and sinusoidal or non-sinusoidal excitation, • have the ability to measure and calculate transient signals in LCR networks, • can perform and evaluate AC measurements with the oscilloscope, • can calculate voltage and current in transformers with sinusoidal excitation, • can calculate voltage and current in multiphase systems.		
Learning content	• **AC:** Characterization of periodic, non-sinusoidal signals, design and characterization of advanced filter circuits, transfer function, amplitude- and phase response, Bode diagram, resonant circuits, multiphase systems • **Transients:** switching current and voltage in basic RLC-networks • **Components:** transformers • **Tools:** Advanced oscilloscope measurements, introduction into measurement automation		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in 4 measurement labs with written reports (PVL)		
Literature	• Bongart, T. (1992): Electric Circuits, McGraw-Hill • Edminister, J. (2011): Schaum's Outline of Electric Circuits, McGraw-Hill Professional • Boylestad, R. (2010): Introductory Circuit Analysis, Prentice Hall • Alexander, C.K. (2012): Fundamentals of Electric Circuits, McGraw-Hill		

Name of module	**Electronics 1**	Abbreviation	ET1/ETL1
Courses	Lecture: Electronics 1 Laboratory: Electronics 1	Semester/ duration	2
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Kapels	Hours per week	3+1
Lecturers	Prof. Dr. Dahlkemper, Prof. Dr. Kapels, Prof. Dr. Missun, Prof. Dr. Wendel	Language	English
Prerequisites	Fundamentals of electrical engineering and mathematics	offered	Academic year
Learning outcomes	The students • have the knowledge of physical function and electrical characteristics of basic components and basic circuits, • know device models and spice simulation of basic electrical circuits.		
Learning content	• **Semiconductor basics:** band model, charge transport, pn-junction, Shockley equation • **Diodes:** structure, characteristics, equivalent circuit, maximum ratings, temperature influence, switching properties, half-wave rectifier, bridge rectifier, Z-diode, spice simulation • **Bipolar transistors:** structure, characteristics, parameters and maximum ratings, small signal model, temperature, dependence, power dissipation and cooling, operating point, amplifier circuits, constant current sources, current mirror, spice simulation • **MOS-Transistors:** structure, characteristics, parameters and maximum ratings, small signal model, operating point, amplifier circuit, constant current source, spice simulation • Subject to modifications and amendments in light of recent events		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercise with written reports (PVL)		
Literature	• Tietze, U.; Schenk, C. (2008): Electronic Circuits: Handbook for Design and Application, Springer Publishing		

Name of module	**Intercultural Competence**	Abbreviation	EE1/EEL1
Courses	Lecture: Intercultural Competence	Semester/ duration	2
Workload	36h attendance, 84h self-study	Credits	3
Module responsibility	-	Hours per week	2
Lecturers	External lecturers	Language	German and/or English
Prerequisites	Germn course of 1st semester	offered	Academic year
Learning outcomes	**Knowledge:** The students • know different aspects and examples of cultural differences, • know about the importance for success in work and everyday life, **Skills:** The students • have a raised critical culture awareness, • have improved language abilities in German and/or English and can effectively communicate in intercultural situations, **Competences:** The students • can apply their understanding of cultural differences to effectively work and cooperate in international teams and to master the challenges of everyday life in Germany.		
Learning content	• Theory of cultural differences in communicative practices taking into account both verbal and non-verbal communication • Intercultural aspects in business and team building • Intercultural aspects of life in Germany • Building practical skills in group work including blended learning: intercultural group work and language learning on electronic platforms • Depending on the language preferences and abilities of the participants, at least a part of lecture is held in German		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, TV/DVD/Video		
Type of Assessment	Lecture: Successful passing in written exam, written report and/or oral presentation (SL)		
Literature	• Chen, G.; Starosta, W. (1998): Foundations of Intercultural Communication, Allyn & Bacon • Apelthauer, E. (2002, Hrsg.): Interkulturelle Kommunikation, Deutschland – Skandinavien – Großbritannien, Narr Verlag • Jandt, F. (2004): Intercultural Communication: A globe reader, Wadsworth Publishing		

Name of module	**Learning and study methods (2)**	Abbreviation	LSL2
Courses	Seminar: Coaching	Semester/ duration	2
Workload	23h attendance, 8h self-study	Credits	2
Module responsibility	Prof. Dr. Leutelt	Hours per week	1,5
Lecturers	External lecturers	Language	English
Prerequisites	None: Introductory course	offered	Academic year
Learning outcomes	The students • know the methodical and organizational tools to complete the course assignments and examinations punctually, effectively and independently using the English language, • have subsequently acquired skills outside of the technical subject area, • have become aware of their personal work and learning techniques with regard to life-long learning strategies and goals, • have the ability to solve problems and complete tasks systematically as well as analyze complex daily situations and set personal goals, • have encouraged self-reflection of the individual learning progress and study success by collateral coaching project that is continued in semester 2.		
Learning content	• Time management • Learning and studying techniques (independently study) • Group workd/ Teamwork/ Group projects • Reading skills • Scientific academic methods • Presentation skills • Dealing with stress • Motivation • Responsibility		
Type of Media	Seminar: Tuition in seminars, blackboard, slides, data projector, TV/DVD/Video		
Type of Assessment	Seminar: Mandatory participation in the coaching project (SL)		
Literature	• Jewler, A.; Gardner, J. (1993): Your College Experience: Strategies for Success, Wadsworth • Garnder, J.; Upcraft, M. (2004): Challenging and Supporting the First-Year Student: A Handbook for Improving the First Year of College, Jossey-Bass • Powell, M. (1996): Presenting in English. How to Give Successful Presentations, Language Teaching Publications		

Name of module	**Signals and Systems 1**	Abbreviation	SS1/SSL1
Courses	Lecture: Signals and Systems 1 Laboratory: Signals and Systems 1	Semester/ duration	3
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Jünemann	Hours per week	3+1
Lecturers	Prof. Dr. Leutelt, Prof. Dr. Jünemann, Prof. Dr. Micheel, Prof. Dr. Rauscher-Scheibe, Prof. Dr. Sauvagerd	Language	English
Prerequisites	Engineering Mathematics 1 and 2, in particular knowledge and ability of: Real and complex functions, Fourier series, linear differential equations with constant coefficients	offered	Academic year
Learning outcomes	The students • can describe periodic and non-periodic signals in the time and frequency domain, • can describe continuous-time, time-invariant (LTI) systems in the time domain and in the frequency as well as the Laplace domain, • understand basic system properties, • can calculate the output signal of a linear system for an arbitrary input signal.		

Learning content	**Lecture:**
	• Introduction to Fourier- and Laplace transformation
	• Contiuous signals in the time and frequency domain
	• LTI systems in time and frequency domains:
	  • Understanding of basic system properties: linearity, time, invariance, causality
	  • Impulse and step response
	  • Complex frequency response
	  • Magnitude response, phase response, and group delay
	• Ideal filter types: low pass, high pass, band pass, band stop filter
	• LTI systems in the Laplace domain:
	  • Transfer function
	  • Pole-zero-map
	  • Stability of LTI systems
	  • Analysis of system output signals from arbitrary input signals
	Laboratory:
	• In the Lab the skills acquired in the lecture will be practiced and applied to solve small, computer-based projects using MATLAB and Simulink. The focus of these projects will be signal generation and signal and system analysis		

Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercises (PVL)		
Literature	• Oppenheim, A.; Willsky, A. (1996): Signals and Systems, Prentice Hall • Strum, R.; Kirk, D. (1999): Contemporary Linear Systems Using Matlab, Brooks Cole Pub • Lee, E.; Varaiya, P. (2002): Structure and Interpretation of Signals and Systems, Addison Wesley • Ziemer, R. (2005): Contiuous and Discrete Signals and Systems, Prentice Hall		

Name of module	**Algorithms and Data Structures**	Abbreviation	AD/ADL
Courses	Lecture: Algorithms and Data Structures Laboratory: Algorithms and Data Structures	Semester/ duration	3
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Dierks	Hours per week	3+1
Lecturers	Prof. Dr. Dierks, Prof. Dr. Renz	Language	English
Prerequisites	Three terms of programming experience	offered	Academic year
Learning outcomes	The students • are familiar with data structures and their portable implementation in a programming language (e.g. Java-API), • are able to describe the construction and execution of basic sorting and searching algorithms and to use them in a given application context, • are able to describe and reproduce the dynamic behavior of algorithms and to gain a basic understanding of complexity in computing, • understand the relation of automata and languages as well as their relevance for program syntax and compilers, • gained knowledge about graph algorithms and optimization.		
Learning content	**Lecture:** • Introduction with elementary algorithms and complexity estimations, complexity • Abstract datatypes, implement • Sorting, Divide-and-Conquer, Pivot, Mergesort, Priority Queue • Search algorithms • Finite-state automata • Deterministic finite automata (without minimization) • Contextfree grammar, syntax tree, syntax analysis and recursive decent • Introduction to graph- and optimization algorithms **Laboratory:** • Empiric detection of complexity depending on problem size by counting the number of steps • Dynamic behavior of sorting algorithms • Tree traversals, search algorithms • Application of scanner and parser generators • Tree and graph traversals		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercises with assessment (preparatory work, documentation, etc.) (PVL)		
Literature	• Sedgewich, R. (2011): Algorithms, Addison-Wesley • Hopcroft, J.; Motwani, R.; Ullman, J. (2006): Introduction to Automata Theory, Languages and Computation, 3rd Edition, Addison-Wesley		

Name of module	**Electronics 2**	Abbreviation	EL2/ELL2
Courses	Lecture: Electronics 2 Laboratory: Electronics 2	Semester/ duration	3
Workload	99h attendance, 111h self-study	Credits	7
Module responsibility	Prof. Dr. Kapels	Hours per week	4+1,5
Lecturers	Prof. Dr. Dahlkemper, Prof. Dr. Kapels, Prof. Dr. Missun, Prof. Dr. Wendel	Language	English
Prerequisites	Fundamentals of electrical engineering 1, Electronics 1 and mathematics	offered	Academic year
Learning outcomes	The students • have the knowledge of basic electrical circuits and their characteristics, • have the ability to design and analyze electrical circuits, • have the knowledge of basic circuits for analog to digital and digital to analog converters.		
Learning content	• **Differential amplifier:** basic electrical circuit, characteristics, properties, improvement with current mirror, spice simulation • **Operational amplifier:** ideal op-amp, internal structure of real op-amp, feedback circuit, stability and frequency response, non-ideal properties, basic electrical circuits with op-amps, applications with op-amps, spice simulation • **Power electronics:** Power-MOSFET and IGBT, MOSFET as switch, switching applications with MOSFETs, spice simulation • **Optoelectronics:** LED, photovoltaic cell, structure, equivalent circuit, MPP • **DA/AD converters:** digital to analog converter, analog to digital converter • subject to modifications and amendments in light of recent events		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory-course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercise with written reports (PVL)		
Literature	• Tietze, U.; Schenk, C. (2008): Electronic Circuits: Handbook for Design and Application, Springer Publishing		

Name of module	**Digital Circuits**	Abbreviation	DI/DIP
Courses	Lecture: Digital Circuits Laboratory: Digital Circuits	Semester/ duration	3
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Reichardt	Hours per week	3+1
Lecturers	Prof. Dr. Leutelt, Prof. Dr. Reichardt, Prof. Dr. Schubert	Language	English
Prerequisites	Basic mathematical and electrical engineering foundations	offered	Academic year

Learning outcomes

The students

- have the ability to describe digital circuits with logical equations, circuit diagrams, timing- and state-diagrams as well as with a hardware description language (HDL),
- have the ability to read digital circuit diagrams and interpret them correctly,
- can develop simple combinational and sequential circuits and analyze and verify their correct static and dynamical functionality using computer aided methods and corresponding target hardware in the lab,
- have the ability to correctly identify and asses logical and timing relations within digital circuits and to draw correct consequences for an optimum circuit design,
- have the ability to analyze combinational circuits with medium scale integrated (MSI) complexity, to synthesise them using minimization schemes and to model them on Register-Transfer- (RT-) Level,
- can convert numbers into different number systems,
- can perform addition and multiplication with positive and negative numbers,
- can chose and apply correct application specific HDL-coding,
- can select appropriate digital HW interfaces,
- understand the function and timing of latches and flipflops,
- can systematically design digital circuits and implement them in programmable logic,
- can apply a HDL coding style which assures identical simulation and synthesis semantics,
- have the ability to model and implement simple state machines,
- have the ability to transfer the gained knowledge from simple applications to more advances applications.

Learning content

- polyadic number systems and codes, including their arithmetical operations in digital domain
- the meaning of twos complement for digital circuits and computer architechture, including basic arithmetic operations
- Boolean algebra
- basic Boolean operations and derived operations like xor and xnor
- analysis of combinational circuits like for example serial, ripple-carry and carry-look-ahead adders resp. subtractors or pseudorandom generators
- synthesis of combinational circuits using minimization techniques like truth tables, Boolean equations, and Karnaugh-Veitch-Diagrams
- synthesis targeted HDL modeling of simple circuits with MSI complexity on register transfer level (RTL), also using symbolic delays
- analysis and HDL modeling of special digital circuit outputs
- synthesis of combinational logic for programmable circuits
- different digital output circuits (Totem Pole, Open-Drain, Tri-State)
- introduction into structure and design of Mealy- and Moore- state machines using state diagrams, state tables, including HDL modeling
- structure, behavior and HDL modeling of state- and edge- driven latches and flipflops
- structure, design and HDL modeling of controlled counters and shift registers
- a HDL coding style which assures identical simulation and synthesis semantics

Name of module	**Digital Circuits**	Abbreviation	DI/DIP
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in lab-courses with written lab preparations, oral examinations and written lab reports (PVL)		
Literature	• Reichardt, J.; Schwarz, B. (2012): VHDL Synthese, 6.A., Oldenbourg Verlag • Reichardt, J. (2011): Lehrbuch Digitaltechnik, 2.A., Oldenbourg Verlag • Wakerly, J.F. (2000): Digital Design Principles & Practices, Prentice Hall • Armstrong, J.R.; Gray, F.G. (2000): VHDL-Design. Representation and Synthesis, Prentice Hall • Brown, S.; Vranesic, Z. (2000): Fundamentals of Digital Logic with VHDL Design, Mc Graw Hill		

Name of module	**Economics and Management**	Abbreviation	EM/EME
Courses	Lecture: Economics and Management Exercises: Economics and Management – Case study	Semester/ duration	3
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Dahlkemper	Hours per week	3+1
Lecturers	Prof. Dr. Dahlkemper, N.N.	Language	Englisch
Prerequisites	Mathematics 1 and 2	offered	Academic year
Learning outcomes	The students • understand general management principles and commonly used tools in companies and have the ability to apply standard methods like SWOT analysis, Balanced Scorecard, • understand cost concepts with the focus on engineering costs and terms related to investment, • have the ability to apply methods of investment analysis to evaluate projects, • have the ability to set up a business plan.		
Learning content	• **Basic Concepts** • **Management:** Strategic Planning (e.g. SWOT analysis), Controlling (e.g. Balanced Score Card) • **Goods and services:** Materials management (Sourcing, Logistics, Supply Chain Management), Production management (Production philosophies, e.g. one-piece-workflow) • **Engineering costs and cost estimating:** Cost concepts, Engineering costs, cost estimating • **Interest and Equivalence:** Cash flow, Time value of money, Equivalence, Investment analysis (Present worth analysis, Annual cash flow analysis, Rate of return analysis) • **Setting up a business plan with case study**		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful passing in case study (presentation and report) (PVL)		
Literature	• Sullivan, W.G.; Wicks, E.M.; Koelling, C.P. (2011): Engineering Economy, Prentice Hall • Newman, D.G. et al. (2004): Engineering Economic Analysis, Oxford University Press • Sepulveda, J.; Souder, W.; Gottfried, B. (1984): Schaum's Outline of Engineering Economics, McGraw-Hill • Junge, P. (2012): BWL für Ingenieure, Gabler Verlag		

Name of module	**Signals and Systems 2**	Abbreviation	SS2/SSL2
Courses	Lecture: Signals and Systems 2 Laboratory: Signals and Systems 2	Semester/ duration	4
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Jünemann	Hours per week	3+1
Lecturers	Prof. Dr. Leutelt, Prof. Dr. Jünemann, Prof. Dr. Micheel, Prof. Dr. Rauscher-Scheibe, Prof. Dr. Sauvagerd	Language	English
Prerequisites	Extensive knowledge of lecture Signals and Systems Theory 1	offered	Academic year
Learning outcomes	The students • are able to describe discrete-time signals and systems as well as stochastic signals in the time and frequency domain, • understand the transmission behavior of discrete-time systems and are able to built measurement sites by checking transmission behavior and responses, • can apply draft methods to design digital filters, • are able to construct and simulate system models using the program MATLAB/Simulink.		
Learning content	**Lecture:** • **Time-discrete signals**: Sampling, sampling theorem, signal reconstruction; DFT. Windowing; Z-transform • **Digital, time-invariant systems**: Difference equations; Impulse- and step response, discrete convolution; Systems finite/infinite impulse response (FIR vs. IIR); Frequency response, magnitude and phase response; Transfer functions, pole-zero map; Basics of digital filter design • **Stochastic signals**: Noise processes, power spectral density; Auto- and cross-correlation functions; LTI systems with stochastic input signals **Laboratory:** • In the Lab the skills acquired in the lecture will be practiced and applied to solve small, computer-based projects using MATLAB and Simulink. The focus of these projects will be signal generation and signal and system analysis		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercises (PVL)		
Literature	• Oppenheim, A.; Willsky, A. (1996): Signals and Systems, Prentice Hall • Strum, R.; Kirk, D. (1999): Contemporary Linear Systems Using Matlab, Brooks Cole Pub • Lee, E.; Varaiya, P. (2002): Structure and Interpretation of Signals and Systems, Addison Wesley • Ziemer, R. (2005): Contiuous and Discrete Signals and Systems, Prentice Hall • Brown, R.; Hwang, P. (1996): Introduction to Random Signals and Applied Kalman Filtering, Wiley and Sons		

Name of module	**Software Engineering**	Abbreviation	SE/SEL
Courses	Lecture: Software Engineering Laboratory: Software Engineering	Semester/ duration	4
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Hotop	Hours per week	3+1
Lecturers	Prof. Dr. Dierks, Prof. Dr. Hess, Prof. Dr. Hotop	Language	English
Prerequisites	Knowledge and ability of module Software Construction 1 and 2, object oriented software construction in JAVA	offered	Academic year
Learning outcomes	The students • have the ability to analyze applications and to realize a requirement analysis, • have the ability to describe applications within the UML (Unified Modeling Language), • can identify the relationship and associations inside applications, • can use case studies to design class and sequence diagrams, • can transfer application description into an object oriented program description, • can design the software for small applications using different software engineering models especially different prototyping models.		
Learning content	• This unit introduces into the basic ideas of the software engineering process and the UML (Unified Modelling Language) • The goal is to construct object oriented software for applications using software engineering methods. • Especially the module focuses on the requirement analysis, the use case study, the sequence and collaboration diagram construction and several other software engineering development diagrams inside a software engineering tool based on UML • The whole process starting with the analysis, via the requirements, the design and realization of software applications is described • Different software development and design models are lined out • All the theoretically knowledge earned has to be transferred into the software construction process for small applications		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation lab-courses with written reports and a short final examination (PVL)		
Literature	• Burckhardt, R. (1999): UML Unified Modeling Language, objektorientierte Modellierung für die Praxis, Addison-Wesley • Booch, G.; Rumbaugh, J.; Jacobson, I. (1999): The Unified Modeling Language User Guide, Addison-Wesley • Douglass, B.P. (2004): Real Time UML: Advances in the UML for Real-Time Systems, Addison-Wesley • Oestereich, B. (2006): Objektorientierte Softwareentwicklung, Analyse und Design mit UML 2.1, Oldenbourg Verlag • Rumbaugh, J.; Jacobson, I.; Booch, G. (2010): The Unified Modeling Language Reference Manual, Addison-Wesley • Sommerville, I. (2010): Software Engineering, Addison-Wesley		

Name of module	**Microcontrollers**	Abbreviation	MC/MCL
Courses	Lecture: Microcontrollers Laboratory: Microcontrollers	Semester/ duration	4
Workload	99h attendance, 111h self-study	Credits	7
Module responsibility	Prof. Dr. Leutelt	Hours per week	4+1,5
Lecturers	Prof. Dr. Leutelt, Prof. Dr. Riemschneider, N.N.	Language	English
Prerequisites	Software Construction 1 and 2, Digital Circuits, good proficiency in programming in C and digital logic/arithmetic, fundamentals of digital hardware	offered	Academic year

Learning outcomes

Knowledge:

The students

- can name different architectures, components and peripheral modules of microcontroller systems and explain their function and characteristics,
- understand how high level language constructs translate into machine level programs,
- have an understanding of the memory organization, the data types and data structures in controller hardware,
- know and understand microcontroller software concepts and constructs including interrupt based design,
- have a basic understanding of handling asynchronous events and time dependencies in programs,

Skills:

The students

- can apply high-level programming languages (e.g. C) to solve hardware oriented tasks,
- can use integrated development tool environments and measurement equipment in order to program and debug microprocessor systems,
- can program internal and external peripheral processor units (e.g. parallel and serial input/output, timer unit, digital to analog converters and analog to digital converters) with direct register addess and/or peripheral driver libraries,

Competencies:

The students

- are able to make an appropriate microcontroller and/or software architecture decision for a given technical application or task,
- are able to familiarize oneself with a new type of microcontroller and/or new peripheral modules.

Learning content

- principles, components and basic functions of a processor
- types, cycles and steps of machine instructions
- comparison of high level programs and assembly programs
- programming and application of
  - parallel input output ports
  - serial interfaces
  - digital to analog converters and analog to digital converters
  - timer units
- basic concepts of subroutines, exceptions and interrupts
- exceptions and interrupts as method to deal with asynchronous events
- hard- and software machanisms for servicing interrupts
- examples of recent aspects and industrial applications of processor systems
- practical training in teams by implementing laboratory projects combining software and hardware aspects, like parallel input, time controlled output, digital voltage, time or frequency measurement, interrupt driven software design

Name of module	**Microcontrollers**	Abbreviation	MC/MCL
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation, lab development equipment Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation lab-courses with review, functional projects and written reports (PVL)		
Literature	• Kernighan, B.; Ritchie, D. (2000): C Programming Language (ANSI C), Markt+Technik Verlag • Patterson, D. (2012): Computer Organization and Design, Morgan Kaufmann Series • Tanenbaum, A. (2012): Structured Computer Organization, Prentice Hall • Yiu, J. (2010): The definitive guide to the ARM Cortex-M3, Newnes • Manual and documentation of the used microcontroller		

Name of module	**Digital Systems**	Abbreviation	DS/DSL
Courses	Lecture: Digital Systems Laboratory: Digital Systems	Semester/ duration	4
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Reichardt	Hours per week	3+1
Lecturers	Prof. Dr. Reichardt, Prof. Dr. Schubert	Language	English
Prerequisites	Basic knowledge and ability of module Digital Circuits	offered	Academic year

Learning outcomes

The students

- have the ability to design state machines using state diagrams and state tables, including the relative timing between the state machine components,
- have the ability to optimize simple and coupled state machines with respect to hardware resources and clock frequency,
- have the ability to let digital subsystems communicate with each other, also under different clock rates,
- have the ability to let digital subsystems communicate with each other, also under different clock rates,
- can model state machines using algorithmic state machine (ASM) descriptions,
- can describe complex digital systems like coprocessors with the concept of partitioned data- and control-path components,
- can apply a CAE based development flow for FPGA implementations, including hardware verification.

Learning content

- A Register-Transfer (RT-) –level based HDL-coding style which is targeted for synthesis, including suitable datatypes and the design of testbenches
- A CAE based design method for FPGAs, including critical path analysis and performing postlayout timing simulations
- Design and modeling of state machines on RT-level
- Decoupling of combined state machines aiming at higher clock frequencies and removal of combinational loops
- Synchronization of sequential circuits (metastability of flipflops, critical path analysis, clock distribution, clock skew)
- Handshake methods to couple digital subsystems
- Methods for state reduction
- Strategies for state encoding including their consequences for transition- and output-logic
- The ASM chart formalism and the generation of ASM charts from textual- and pseudocode-descriptions
- Design principles for coprocessors (system partitioning into data- and control-path, optimization strategies like pipelining and resource sharing

Type of Media

Lecture: Tuition in seminars, blackboard, slides, computer simulation

Laboratory: Laboratory- and computerpractical course

Type of Assessment

Lecture: Successful passing in written exam (PL)

Laboratory: Successful participation in lab-courses with written lab preparations, oral examinations and written lab reports (PVL)

Literature

- Reichardt, J.; Schwarz, B. (2012): VHDL Synthese, 6.A., Oldenbourg Verlag
- Reichardt, J. (2011): Lehrbuch Digitaltechnik, 2.A., Oldenbourg Verlag
- Brown, S.; Vranesic, Z. (2000): Fundamentals of Digital Logic with VHDL Design, Mc Graw Hill
- Zwolinski, M. (2000): Digital System Design with VHDL, Prentice Hall
- Pernards, P. (1995): Digitaltechnik-II, Hühtig Verlag

Name of module	**Databases**	Abbreviation	DB/DBL
Courses	Lecture: Databases Laboratory: Databases	Semester/ duration	4
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Wöhlke	Hours per week	3+1
Lecturers	Prof. Dr. Wöhlke, Prof. Dr. Suhl	Language	English
Prerequisites	Basic knowledge and ability of module software construction 1, 2 and 3	offered	Academic year
Learning outcomes	The students • have the ability to design a relational database system, • have the knowledge of Entity Relationship Modeling, Normalization, Structured Query Language.		
Learning content	• History • Database Management Systems • Entity Relationship Model • Algebra of Relations • Normalization • Structured Query Language		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in the laboratory (PVL)		
Literature	• Kähler, W.-M. (2008): SQL mit ORACLE, Vieweg Verlag • Heuer, A. (2000): Datenbanken Konzepte und Sprachen, mitp Verlag		

Modulbezeichnung	**Praxissemester mit Kolloquium**	Kürzel	Praxis
Lehrveranstaltung(en)	Praxissemester Kolloquium	Semester/ Dauer	5
Arbeitsaufwand	54 Std. Präsenz, 696 Std. Praktikum (20 Wochen)	CP	20+5
Modulverantwortliche(r)	Vorsitzender des Prüfungsausschusses des Studiengangs	SWS	3
Dozenten	Alle Professorinnen und Professoren des Departments	Sprache	deutsch
Teilnahmevoraussetzungen		Häufigkeit	je Semester
Lernziele und Kompetenzen	**Fachlich-inhaltliche und methodische Kompetenzen:** • Entsprechend der Profilbildung wird das Fachwissen vorrangig durch Selbststudium vertieft, die Arbeit im Team sowie die Schlüsselqualifikationen zur Herausbildung der Ingenieurpersönlichkeit geübt und vervollkommnet. • Die Studierenden sollen die im Studium erworbenen fachlichen und sozialen Kompetenzen im Rahmen eines betrieblichen Praktikums in Unternehmen anwenden und dabei die Anforderungen, die an einen Ingenieur in einem Unternehmen gestellt werden, kennen lernen. • Die Studierenden sollen die komplexen Zusammenhänge industrieller Aufgabenstellungen bewerten können und die im Studium erworbenen fachlichen Kenntnisse und Problemlösungsmethoden zur Lösung der Aufgaben anwenden. • Die Studierenden sollen die Strukturen, Abläufe und Organisation in einem Unternehmen kennen lernen und die Einordnung ihrer Aufgabe in die Forschungs-, Entwicklungs- und Projektarbeit in dem Unternehmen bewerten. • Die Studierenden sollen die Randbedingungen, die der Stand der Technik und die gesetzlichen Regelungen, Normen und Standards, auf die Lösung der Aufgabenstellung erfasst haben. **Sozial- und Selbstkompetenzen:** • Erstellung von Aufgabenstellungen mit fachübergreifendem Charakter • Koordination von Arbeitsaufgaben im Rahmen der Aufgabenbearbeitung • Führung und Anleitung im Team • Erkennung und Definition von Schnittstellen bei der Bearbeitung von fachübergreifenden Aufgabenstellungen • Auswertung und Bewertung der ingenieur-technischen Lösung sowie eine wirtschaftliche Betrachtung der Ergebnisses, sie sind in der Lage fachfremde Mitarbeiter in die Lösung zu integrieren. – • Die Studierenden sollen die Normen und Regeln der Zusammenarbeit in einem Unternehmen kennen und deren Einfluss auf den Erfolg des Unternehmens bewerten lernen. • Die Studierenden sollen die internationale Verflechtung in einem bzw. eines Unternehmens mit der globalisierten Welt kennen lernen und daraus die Anforderung an ihre eigene Person ableiten. • Die Studierenden sollen die Notwendigkeit der Teamfähigkeit erkennen und ihre individuellen Stärken und Schwächen in einem beruflichen Umfeld einschätzen können.		
Inhalte	Das Hauptpraktikum umfasst 20 Wochen. Individuelle Aufgabenstellung entsprechend der Lernziele in Abstimmung zwischen einem Professor und dem Unternehmen.		
Lehr- und Lernformen	Praktikum		
Studien- und Prüfungsleistungen	Praktikumsbericht und erfolgreicher Abschluss des Kolloquiums (SL)		

Name of module	**Scientific and project work**	Abbreviation	SP
Courses	Lecture: Scientific and project work (block course)	Semester/ duration	5
Workload	36h attendance, 84h self-study	Credits	4
Module responsibility	Prof. Dr. Leutelt	Hours per week	2
Lecturers	External lecturers	Language	Englisch
Prerequisites	none	offered	Academic year
Learning outcomes	The students • have the ability to organize and to present the project results and other presentations as well as writing the bachelor report methodically correct and successful, • know the basic principles of project management and are able to plan, implement and work effectively in small to medium size projects.		
Learning content	• Writing of scientific papers, methodically preparting the Bachelor report • Scientific work • Analysis of source material, working with literature and references (investigation, online-search, reference rules) • Working in teams/projects/group work • Fundamentals of project management • Conflict management • Students practice project work with a small technical or non-technical task		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in oral presentations and written report (PL)		
Literature	• Rossig, W.E.; Prätsch, J. (2005): Wissenschaftliches Arbeiten, Print-Tec Druckverlag Weyhe • Esselborn-Krumbiegel, H. (2004): Von der Idee zum Text: Eine Anleitung zum wissenschaftlichen Arbeiten, Schöningh Verlag • Stickel-Wolf, C.; Wolff, J. (2005): Wissenschaftliches Arbeiten und Lerntechniken: Erfolgreich studieren – gewusst wie!, Gabler Verlag • Schulz v. Thun, F. (2006): Miteinander reden (Band 1-3), Rowohlt Tb		

Name of module	**Praxissemester mit Kolloquium**	Abbreviation	Praxis
Courses	Praxissemester Kolloquium	Semester/ duration	5
Workload	54 h attendance, 696 h internship (20 weeks)	Credits	20+5
Module responsibility	Vorsitzender des Prüfungsausschusses des Studiengangs	Hours per week	3
Lecturers	Alle Professorinnen und Professoren des Departments	Language	deutsch
Prerequisites		offered	je Semester
Learning outcomes	**Fachlich-inhaltliche und methodische Kompetenzen:** • Entsprechend der Profilbildung wird das Fachwissen vorrangig durch Selbststudium vertieft, die Arbeit im Team sowie die Schlüsselqualifikationen zur Herausbildung der Ingenieurpersönlichkeit geübt und vervollkommnet. • Die Studierenden sollen die im Studium erworbenen fachlichen und sozialen Kompetenzen im Rahmen eines betrieblichen Praktikums in Unternehmen anwenden und dabei die Anforderungen, die an einen Ingenieur in einem Unternehmen gestellt werden, kennen lernen. • Die Studierenden sollen die komplexen Zusammenhänge industrieller Aufgabenstellungen bewerten können und die im Studium erworbenen fachlichen Kenntnisse und Problemlösungsmethoden zur Lösung der Aufgaben anwenden. • Die Studierenden sollen die Strukturen, Abläufe und Organisation in einem Unternehmen kennen lernen und die Einordnung ihrer Aufgabe in die Forschungs-, Entwicklungs- und Projektarbeit in dem Unternehmen bewerten. • Die Studierenden sollen die Randbedingungen, die der Stand der Technik und die gesetzlichen Regelungen, Normen und Standards, auf die Lösung der Aufgabenstellung erfasst haben. **Sozial- und Selbstkompetenzen:** • Erstellung von Aufgabenstellungen mit fachübergreifendem Charakter • Koordination von Arbeitsaufgaben im Rahmen der Aufgabenbearbeitung • Führung und Anleitung im Team • Erkennung und Definition von Schnittstellen bei der Bearbeitung von fachübergreifenden Aufgabenstellungen • Auswertung und Bewertung der ingenieur-technischen Lösung sowie eine wirtschaftliche Betrachtung der Ergebnisses, sie sind in der Lage fachfremde Mitarbeiter in die Lösung zu integrieren. – • Die Studierenden sollen die Normen und Regeln der Zusammenarbeit in einem Unternehmen kennen und deren Einfluss auf den Erfolg des Unternehmens bewerten lernen. • Die Studierenden sollen die internationale Verflechtung in einem bzw. eines Unternehmens mit der globalisierten Welt kennen lernen und daraus die Anforderung an ihre eigene Person ableiten. • Die Studierenden sollen die Notwendigkeit der Teamfähigkeit erkennen und ihre individuellen Stärken und Schwächen in einem beruflichen Umfeld einschätzen können.		
Learning content	Das Hauptpraktikum umfasst 20 Wochen. Individuelle Aufgabenstellung entsprechend der Lernziele in Abstimmung zwischen einem Professor und dem Unternehmen.		
Type of Media	Praktikum		
Type of Assessment	Praktikumsbericht und erfolgreicher Abschluss des Kolloquiums (SL)		

Name of module	**Bus systems and Sensors**	Abbreviation	BU/BUL
Courses	Lecture: Bussystems and Sensors Laboratory: Bussystems and Sensors	Semester/ duration	6
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Schubert	Hours per week	3+1
Lecturers	Prof. Dr. Meiners, Prof. Dr. Schubert, Prof. Dr. Dahlkemper	Language	English
Prerequisites	Electronic 1, 2 and 3	offered	Academic year
Learning outcomes	The students • have the knowledge of the principles of sensors, • have the knowledge of circuits of processing of sensor signals, • have the knowledge of characteristics of bus systems and of requirements for bus systems, • have the ability to analyze, develop and check important components of circuits for the processing of sensor signals, • have the ability to define requirements for linking solutions and to choose bus systems for the realization, • have the ability to integrate electronic devices into bus systems.		
Learning content	• Structure of data acquisition and distribution systems • Principles of sensors, characteristics and time behavior • Processing of sensor signals • Application examples for circuits with sensors • Introduction into bus systems • Basics of bus systems • Bus lines • Special bus systems (e.g. PCI, CAN, LON, I^2C) • The right to chance and add actual topics is reserved		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation lab-courses (PVL)		
Literature	• Tietze, U.; Schenk, C. (2012): Halbleiter-Schaltungstechnik, Springer Verlag • Weissel, R.; Schubert, F. (1995): Digitale Schaltungstechnik, Springer Verlag • Schanz, G. (2004): Sensoren, Hüthig Verlag • Dembowski, K. (2001): Computerschnittstellen und Bussysteme, Hüthig Verlag • References to actual bussystems		

Name of module	**Operating Systems**	Abbreviation	OS/OSL
Courses	Lecture: Operating Systems Laboratory: Operating Systems	Semester/ duration	6
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Schneider	Hours per week	3+1
Lecturers	Prof. Dr. Dierks, Prof. Dr. Leutelt, Prof. Dr. Renz, Prof. Dr. Riemschneider	Language	English
Prerequisites	Software Construction 1, 2 and 3, Computer Architecture	offered	Academic year
Learning outcomes	The students • have an overview about existing operating systems and their individual characteristics, • have the ability to use different OS resources in order to program dedicated application tasks, • have the ability to design and realize complex systems using the available OS resources.		
Learning content	• Multitasking methods • Communication and synchronization • Resource sharing and timing control • Interaction with external signals • I/O programming, OS driver basics • OS comparison and selection • Selected topics in modern OS • Exemplary applications during the lab with in-depth system-analysis and -realisation		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in lab-courses with lab preparations with reviews, functional programs, lab reports (PVL)		
Literature	• Tanenbaum, A.S. (2009): Modern Operating Systems, Prentice Hall • Kernighan, B.W.; Ritchie, D. M. (2000): The C-Programming Language (ANSI C), Markt+Technik Verlag • Kerrisk, M. (2010): The Linux Programming Interface, No Starch Press • Corbet, J. et al. (2005): Linux Device Drivers, O'Reilly		

Name of module	**Digital Signal Processing**	Abbreviation	DP/DPL
Courses	Lecture: Digital Signal Processing Laboratory: Digital Signal Processing	Semester/ duration	6
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Sauvagerd	Hours per week	3+1
Lecturers	Prof. Dr. Kölzer, Prof. Dr. Reichardt, Prof. Dr. Sauvagerd, Prof. Dr. Vollmer	Language	English
Prerequisites	Adequate knowledge of mathematics and signals and systems, basics of C-programming	offered	Academic year

Learning outcomes

The students

- have the knowledge of the typical setup of a DSP-system and its components,
- understand basic techniques of digital signal processing like DFT, FFT, convolution, correlation, FIR and IIR filtering and their implementation on a DSP platform using DSP-programs,
- have the ability to analyze independently typical problems arising in digital signal processing and propose solutions,
- know how to use MATLAB for the simulation of algorithms,
- have the ability to implement these algorithms on a DSP platform,
- have the ability to design digital filters,
- have the ability to carry out spectral analysis by using DFT and judge the results,
- can analyze, judge and design problem solutions in the field of digital signal processing.

Learning content

Lecture:

- Introduction into the
  - development process
  - simulation tool MATLAB/Simulink
  - DSP architecture
  - DSP development system
- Digital signal processing:
  - digitizing and recovering of analog signals
  - number representation
  - finite precision effects, signal scaling
  - DFT (discrete Fourier transform), frequency and amplitude resolution
  - windowing techniques
  - convolution and correlation
  - FIR and IIR filter design
  - Impulse invariance method and bilinear transformation method
  - Fast Fourier Transformation (FFT)

Laboratory:

- develop and simulate algorithms with MATLAB/Simulink
- work with DSP development system, implementation examples:
  - digitizing and recovery of analog signals
  - DFT/FFT algorithms
  - FIR-filters, IIR-filters

Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course
Type of Assessment	Lecture: Successful passing in written exam (PL)

Name of module	**Digital Signal Processing**	Abbreviation	DP/DPL
	Laboratory: Successful participation in lab-courses with written lab preparations, oral examinations and written lab reports (PVL)		
Literature	• Tretter, S.A. (1993): Communication System Design Using DSP Algorithms, Kluwer Academic Plenum Publishers • Mitra, S.K. (2000): Digital Signal Processing: A Computer-Based Approach, McGraw-Hill • Proakis, M. (1996): Digital Signal Processing, Prentice Hall • Ifeachor, J. (2002): Digital Signal Processing – A Practical Approach, Addison-Wesley • Chassaing, R. (2010): Digital Signal Processing and Applications with TMS320C6713, Wiley		

Name of module	**Digital Communication Systems**	Abbreviation	DC/DCL
Courses	Lecture: Digital Communication Systems Laboratory: Digital Communication Systems	Semester/ duration	6
Workload	72h attendance, 108h self-study	Credits	6
Module responsibility	Prof. Dr. Vollmer	Hours per week	3+1
Lecturers	Prof. Dr. Vollmer, N.N.	Language	English
Prerequisites	Adequate knowledge of mathematics, signals and systems	offered	Academic year
Learning outcomes	The students • have gained insight the structure and operating mode of a digital communication system, • are able to split a complete system into suitable system blocks, • are able to describe the main properties of these blocks and to define the block requirements in respect of a given application, • have the ability to describe the behavior of the blocks by mathematical equations, • have the knowledge and ability to apply basic measurement techniques.		
Learning content	**Lecture:** • digitizing and reconstruction of analog signals • distortionless digital signal transmission • channel equalizing • clock recovery • disturb signal interferences • bit error rate for AWGN-channels • digital modulation Changes and additions due to actual occasions reserved **Laboratory:** • dimensioning and verification of digital systems hardware blocks • implementation and test of the complete transmission system • examples for hardware blocks: digitizer and interpolation filters, regenerative repeater, correlative encoder/decoder, equalizer, FSK-modulator/demodulator Other topics of the lecture are also possible		
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Lecture: Successful passing in written exam (PL) Laboratory: Successful participation in lab-courses with written lab preparations, oral examinations and written lab reports (PVL)		
Literature	• Gerdsen, P. (1996): Digitale Nachrichtenübertragung, Teubner Verlag • Sklar, B. (2001): Digital Communications – Fundamentals and Applications, Prentice Hall • Proakis, J. (2008): Digital Communications, McGraw-Hill		

Name of module	**Elective Project 1**	Abbreviation	CJ1
Courses	Project: Elective Project 1 (individual or group project)	Semester/ duration	6
Workload	45h attendance, 105h self-study	Credits	5
Module responsibility	Prof. Dr. Leutelt	Hours per week	3
Lecturers	all professors and lecturers of the department	Language	English
Prerequisites	Scientific and project work, economics and management	offered	Academic year
Learning outcomes	The students • have explored a subject of Information Engineering at greater depth and gained the corresponding specialized knowledge, • know how to structure a complex task into work packages and complete them within a given time frame, • are able to find literature and to acquire the required theoretical knowledge, • have the ability to work in a team and to handle team related issues, • can document project status and achieved results in an formal correct manner, • know how to independently approach, solve and document a new and complex task.		
Learning content	• The students explore a subject of Information Engineering at greater depth in a project typical way. • The task can be either defined by a supervising professor or by the students themselves, e.g. in cooperation with the company for which the student worked during his or her industrial placement. In the latter case the appropriateness must be approved by a supervising professor. • The task shall be solved preferably in group work, however projects by individuals are possible, too. • Project management techniques, as learned from former lectures, have to be applied. • The written report plays a significant role in this project in order to prepare for the Bachelor thesis. Therefore in group work, every student has to demonstrably contribute to it.		
Type of Media			
Type of Assessment	Project: Successful participation in the project with task completion and quality of results and a written report (PL)		
Literature	• Text books, scientific papers and online resources dependent on the chosen topic		

Name of module	**Elective Project**	Abbreviation	CJ1
Courses	Project: Elective Project (individual or group project)	Semester/ duration	6
Workload	45h attendance, 105h self-study	Credits	5
Module responsibility	Prof. Dr. Leutelt	Hours per week	3
Lecturers	all professors and lecturers of the department	Language	English
Prerequisites	Scientific and project work, economics and management	offered	Academic year
Learning outcomes	The students • have explored a subject of Information Engineering at greater depth and gained the corresponding specialized knowledge, • know how to structure a complex task into work packages and complete them within a given time frame, • are able to find literature and to acquire the required theoretical knowledge, • have the ability to work in a team and to handle team related issues, • can document project status and achieved results in an formal correct manner, • know how to independently approach, solve and document a new and complex task.		
Learning content	• The students explore a subject of Information Engineering at greater depth in a project typical way. • The task can be either defined by a supervising professor or by the students themselves. In the latter case the appropriateness need to be approved by a supervising professor. • The task shall be solved preferably in group work, however projects by individuals are possible, too. • Project management techniques, as learned from former lectures, have to be applied. • The written report plays a significant role in this project in order to prepare for the Bachelor thesis. Therefore in group work, every student has to demonstrably contribute to it.		
Type of Media			
Type of Assessment	Project: Successful participation in the project with task completion and quality of results and a written report (PL)		
Literature	• Text books, scientific papers and online resources dependent on the chosen topic		

Name of module	**Elective Course 1**	Abbreviation	CM1/CML1
Courses	Seminar: Elective Course 1 Laboratory: Elective Course 1	Semester/ duration	7
Workload	72h attendance, 78h self-study	Credits	5
Module responsibility	Prof. Dr. Dierks	Hours per week	3+1
Lecturers	Prof. Dr. Dierks	Language	English
Prerequisites	Adequate knowledge of mathematics, programming skills in a language like JAVA, software construction 1, 2 and 3	offered	Academic year
Learning outcomes	The students • have the knowledge of formal description of both syntax and semantics of programs, • have the knowledge of verification methods for partial and total correctness.		
Learning content	**Lecture:** • sequential programs, correctness formulas, operational semantics, partial correctness, total correctness, proof rules, soundness, completeness • parallel programs with disjoint and shared variables, interference and interference freedom • parallel programs with synchronization, deadlock, deadlock-freedom • recursive programs, termination thereof **Laboratory:** • application of theoretical contents to standard JAVA programs • introduction to verification tools, e.g. Model-checkers		
Type of Media	Seminar Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Seminar: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercises with assessment (preparatory work, documentation, etc.) (PVL)		
Literature	• Apt, K.; Olderog, E.-R. (2009): Verification of Sequential and Concurrent Programs, Springer		

Modulbezeichnung	**Wahlflichtprojekt**	Kürzel	PO
Lehrveranstaltung(en)	Projekt: Entwicklung einer Controller-Platine	Semester/ Dauer	7
Arbeitsaufwand	72 Std. Präsenz, 78 Std. Selbststudium	CP	5
Modulverantwortliche(r)	Prof. Dr. Schneider	SWS	4
Dozenten	Prof. Dr. Schneider	Sprache	deutsch
Teilnahmevoraussetzungen	Grundlagenkenntnisse in Computertechnik, Elektronik und Software-Entwicklung, wie sie primär im ersten bis vierten Semester des Studiums der Elektrotechnik und Informationstechnik erworben werden	Häufigkeit	Semester
Lernziele und Kompetenzen	Die Studierenden • können ein umfangreiches Elektronikprojekt inhaltlich und zeitlich planen und durchführen, • können eine Präsentation zur Projektplanung erstellen und vortragen, • können eine Controller-Platine entwerfen und mit einem Layout-Programm zur Fertigungsreife bringen, • können eine Controller-Schaltung mit analoger und digitaler Peripherie erfolgreich aufbauen und in Betrieb nehmen, • können die Firmware für eine Controller-Platine in der Programmiersprache C erstellen.		
Inhalte	• Planung eines umfangreichen Elektronikprojekts • Entwicklung einer Controller-Schaltung mit analoger und digitaler Peripherie • Umsetzung einer Controller-Schaltung mit Hilfe eines Layout-Programms in eine Platine • Zusammenbau und Inbetriebnahme einer Controller-Platine • Fehlersuche auf einer Controller-Platine • Erstellen von Firmware für eine Controller-Platine • Debuggen der Firmware für eine Controller-Platine		
Lehr- und Lernformen	Tafelarbeit, Overhead- bzw. Rechnerpräsentation		
Studien- und Prüfungsleistungen	Projektarbeit (Planungspräsentation, Ergebnispräsentation, Projektbericht) (PL)		
Literatur	• Kernighan, B.; Ritchie, D. (1990): Programmieren in C, Carl-Hanser Verlag • Kethler, A.; Neujahr, M. (2009): Leiterplattendesign mit EAGLE, Mitp Verlag • Schmitt, G. (2008): Mikrocomputertechnik mit Controllern der Atmel AVR-RISC-Familie, Oldenbourg Verlag		

Name of module	**Elective Project 2**	Abbreviation	CJ2
Courses	Project: Development of a Controller board	Semester/ duration	7
Workload	72h attendance, 78 h self-study	Credits	5
Module responsibility	Prof. Dr. Schneider	Hours per week	4
Lecturers	Prof. Dr. Schneider	Language	English
Prerequisites	Prerequisites: lectures on microcontrollers, electronics and software construction of the semesters 1-4	offered	Academic year
Learning outcomes	The students are able • to plan and conduct a comprehensive electronic project, • to create and present a project planning, • to design a controller board ready for production with PCB (printed circuit board) layout tools • to equip a PCB with a controller circuit including analog and digital peripheral components and put it successfully into operation, • to create a firmware for the controller board in C language.		
Learning content	• planning of a comprehensive electronic project • Development of a controller circuit with analog and digital peripheral components • Design a PCB for a controller circuit with an Electronic Design Automation layout tool • Assembly, equipment and operating the controller board • Testing and debugging of a controller board • Design firmware for a controller board • Debug firmware for a controller board		
Type of Media	Lab work supported by seminars, blackboard, slides, computer simulation		
Type of Assessment	Project: Successful participation in the project with task completion and quality of results and a written report (PL)		
Literature	• Kernighan, B.; Ritchie, D. (1990): *The C Programming Language*. 2. Auflage. Prentice Hall, Englewood Cliffs, N.J. 1988 • Williams (2003): Build Your Own Printed Circuit Board, Tab Books • Schmitt, G. (2008): Mikrocomputertechnik mit Controllern der Atmel AVR-RISC-Familie, Oldenbourg Verlag		

Name of module	**Elective Course 2**	Abbreviation	CM2/CML2
Courses	Seminar: Elective Course 2 Laboratory: Elective Course 2	Semester/ duration	7
Workload	72h attendance, 78h self-study	Credits	5
Module responsibility	Prof. Dr. Reichardt	Hours per week	3+1
Lecturers	Prof. Dr. Reichardt	Language	English
Prerequisites	Successful completion of modules Digital Circuits, Digital Systems and Microcontrollers	offered	Academic year
Learning outcomes	The students • have the ability to configure a FPGA based HW/SW system, • have the ability to apply FPGA design and verification tools correctly, • have the ability to design and integrate VHDL based user IP-cores into an existing HW/SW system, • have the ability to program FPGA based embedded SW for real-time applications.		
Learning content	• State of the art platform FPGA technologies • FPGA based processor technologies • Embedded system HW/SW design environment • SW driver technology for HW-IPs • Embedded SW concepts • Embedded SW verification concepts		
Type of Media	Seminar: Tuition in seminars, blackboard, slides, computer simulation Laboratory: Laboratory- and computerpractical course		
Type of Assessment	Seminar: Successful passing in written exam (PL) Laboratory: Successful participation in laboratory exercises with written lab preparations, oral examinations, lab performance and written lab reports (PVL)		
Literature	• Sass, R.; Schmidt, G. (2010): Embedded System Design with Platform FPGAs, Morgan Kaufmann • Chu, P.P. (2008): Prototyping by VHDL Examples: Xilinx Spartan-3 Version, Wiley • Reichardt, J.; Schwarz, B. (2012): VHDL Synthese, Oldenbourg Verlag • Reichardt, J. (2011): Lehrbuch Digitaltechnik, Oldenbourg Verlag • FPGA manufacturers design- and application notes		

Name of module	**Bachelor Thesis**	Abbreviation	BA
Courses	Bachelor Thesis	Semester/ duration	7
Workload	450 h self-study	Credits	12 + 3 CP
Module responsibility	Vorsitzender des Prüfungsausschusses des Studiengangs	Hours per week	-
Lecturers		Language	German/ english
Prerequisites	Die Bachelorarbeit kann angemeldet werden, wenn alle bis auf drei Modulprüfungen erfolgreich abgelegt worden sind. Der Umfang der noch fehlenden Studien-, Prüfungsvor- und Prüfungsleistungen darf 15 Kreditpunkte nicht übersteigen.	offered	je Semester
Learning outcomes	**Fachlich-inhaltliche und methodische Kompetenzen:** Die Studierenden • sind in der Lage, eine komplexe Aufgabenstellung aus den wissenschaftlichen, anwendungsorientierten oder beruflichen Tätigkeitsfeldern des Studiengangs selbstständig unter Anwendung wissenschaftlicher Methoden und Erkenntnisse zu bearbeiten und dabei in die fächerübergreifenden Zusammenhänge einzuordnen. • können ihr Theorie- und Methodenwissen selbstständig anwenden, • verfügen über vertiefte Problemlösungskompetenz, • kennen die Randbedingungen, den Stand der Technik und die gesetzlichen Regelungen, Normen und Standards, der für die Lösung der Aufgabenstellung relevanten Gegenstandsbereiche, • können die Lösungsansätze darstellen, bewerten und diskutieren - in schriftlicher Form und als Referat, **Sozial- und Selbstkompetenzen:** Die Studierenden • können Aufgabenstellungen mit fachübergreifendem Charakter bearbeiten und können dabei Schnittstellen erkennen und definieren, • können ingenieurtechnische Lösungen auswerten und bewerten und die Ergebnisse wirtschaftlich betrachten, • können die Ergebnisse wissenschaftlich darstellen und präsentieren und komplexe Zusammenhänge in kurzer schriftlicher Form möglichst umfassend darstellen und das Wesentliche vom Unwesentlichen unterscheiden.		
Learning content	Die Bachelorthesis ist eine theoretische, programmiertechnische, empirische und/ oder experimentelle Abschlussarbeit mit schriftlicher Ausarbeitung. In der Bachelorarbeit sollen die Studierenden zeigen, dass sie in der Lage sind, ein Problem aus den wissenschaftlichen, anwendungsorientierten oder beruflichen Tätigkeitsfeldern dieses Studiengangs selbständig unter Anwendung wissenschaftlicher Methoden und Erkenntnisse zu bearbeiten und dabei in die fächerübergreifenden Zusammenhänge einzuordnen. Die Bearbeitung erfolgt in der Regel in folgenden Phasen: • Einarbeitung in die Thematik und in den aktuellen Stand der Technik/Forschung. • Einarbeitung/Auswahl der Methoden und Techniken zur Problemlösung. • Entwicklung eines Lösungskonzeptes. • Implementierung/Realisierung des eigenen Konzeptes/Ansatzes. • Validierung und Bewertung der Ergebnisse. • Darstellung der Ergebnisse in schriftlicher Form. • Kolloquium bestehend aus einem Referat mit anschließender Diskussion. In der Bachelorarbeit wird eine individuelle Aufgabenstellung entsprechend der Lernziele in Abstimmung zwischen einer Professorin oder einem Professor und einem Unternehmen oder eine Aufgabenstellung im Rahmen der Projektbearbeitung an der Hochschule bearbeitet. Die Festlegung der Aufgabenstellung erfolgt immer durch eine Hochschullehrerin oder einen Hochschullehrer.		
Type of Media	Selbstständige wissenschaftliche Arbeit		

Name of module	**Bachelor Thesis**	Abbreviation	BA
Type of Assessment	Schriftliche Ausarbeitung (12 CP) und Kolloquium mit Vortrag und Prüfungsgespräch (3 CP)		
Literature	H. Corsten, J. Deppe: Technik des wissenschaftlichen Arbeitens. 3. Auflage. München 2008. N. Franck, J. Stary: Die Technik wissenschaftlichen Arbeitens. Eine praktische Anleitung, 15. Aufl., Paderborn, 2009. M. Kornmeier: Wissenschaftlich schreiben leicht gemacht: für Bachelor, Master und Dissertation, 4. Aufl., UTB (Haupt- Verlag), Bern 2011. A. Brink: Anfertigung wissenschaftlicher Arbeiten. 3. Auflage. München/Wien 2007. T. Plümper: Effizient Schreiben: Leitfaden zum Verfassen von Qualifizierungsarbeiten und wissenschaftlichen Texten, Oldenbourg Verlag, 2003.		