Fakultät Technik und Informatik
Department Informations- und Elektrotechnik

Module Handbook

Degree Program
Information Engineering (B.Sc.)

01.04.2024

Department Informations- und Elektrotechnik
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Assessment Types

According to § 14 APSO-INGI, as currently applicable, the assessment types for the following module handbook are defined as follows:

1. Case study (Fallstudie / FS)
A case study is a piece of written work presenting a reasoned solution to a set problem. Students work either individually or in a group to establish, analyse and solve specific problems in practice by applying scientific and academic methods and findings. Case studies are set for specific classes, and must be completed in the same semester as the class and by the time the class ends. The programme-specific examination and study regulations may contain more detailed provisions on the time available for case studies.

2. Home project (Hausarbeit / H)
A home project is a piece of written work, to be produced by the student on his or her own and outside class hours, in which the student is to prove that he or she is able to investigate and analyse a set question or subject independently. A maximum of three months is allowed for completion. If the home project constitutes an examination, the programme-specific examination and study regulations may specify whether or not a colloquium is to be held once the written project has been submitted. Colloquia should last between 15 and 45 minutes, and are generally to be held within one month of submission of the written work.

3. Written examination (Klausur / K)
A written examination is completed under supervision. Students must complete the set questions on their own, either without the use of study aids or with the use of specified study aids only. Written examinations last at least 60 and no longer than 240 minutes.

4. Colloquium (Kolloquium / KO)
A colloquium may be required as part of certain types of examination, or in combination with the Bachelor or Master thesis. A colloquium is an oral examination in which students must prove their knowledge of the material examined, speaking and responding freely in an open discussion. A colloquium lasts at least 15 and no more than 45 minutes, and is also aimed at establishing that the written work submitted was all the student's own work. Colloquia can be organised as individual or group examinations. The size of the group for group examinations should be considered accordingly when setting the length of the examination.

5. Construction task (Konstruktionsarbeit / KN)
A construction task is a piece of written work in which the student must prove his or her design skills by solving practical tasks. A maximum of three months is allowed for completion.

6. Lab work completion (Laborabschluss / LA)
Lab work is successfully completed when students have successfully conducted the experiments set by the examiner during the semester and have demonstrated their knowledge by taking part in corresponding colloquia and/or by submitting written records of their work and/or by completing set written tasks. Colloquia last for a minimum of 15 and a maximum of 45 minutes. The written work must be submitted by a deadline set by the examiner; the latest deadline is the end of the semester in which the class in question was taken.

7. Lab work examination (Laborprüfung / LR)

Lab work examination consists of the completion of lab work and a final examination at the end of the class. In the examination, the student is required to conduct and solve an experiment on his or her own and independently. Examinations last at least 60 and no more than 240 minutes.

8. Oral examination (Mündliche Prüfung / M)
In an oral examination, a student must demonstrate in discussion with the examiner that he or she fully understands the material on which he or she is being examined. Oral examinations generally last at least 15 and no more than 45 minutes. Oral examinations may be conducted as individual or group examinations, and are to be conducted by one examiner and one assessor in accordance with Section
An oral examination may alternatively be conducted by two or more examiners instead of one, i.e. by a panel of examiners; in such a case, the student is to be examined by one examiner only in each of the various examination subjects. Oral examinations are always assessed and graded by one examiner only, no matter whether they are conducted by several examiners or by an examiner and an assessor. The examiner responsible for grading in each case must consider the views of the other examiners/the assessor before deciding on the grade to be awarded. The main aspects covered in and results of each oral examination are to be recorded. The record is signed by the examiners and assessor and is filed with the examination documents.

9. Project (Projekt / Pj)
A project is an interdisciplinary task relating to the area of industry or business for which the course is designed. The results of projects must be documented. At least 6 and no more than 26 weeks are allowed for projects. Project work is generally completed with a colloquium. The applicable programme-specific examination and study regulations may specify additional requirements in terms of the form, content and goal of the project, and may specify another form of final assessment instead of a colloquium.

10. Paper (Referat / R)
A paper is a presentation lasting between 15 and 45 minutes on the basis of written preparation by the student. A paper is followed by a discussion led by the student or tutor. Papers should not be read out from detailed notes; students should be able to speak spontaneously. Digital or hard copies of any presentations and graphics used are to be submitted to the examiner. The detailed written paper to be submitted to the examiner should summarise the key findings and conclusions.

11. Test (T)
Tests are pieces of written work in which students demonstrate their ability to solve set tasks in a clearly defined subject area under examination conditions. Tests last at least 15 and no more than 90 minutes. The programme-specific examination and study regulations may specify that test results are to be included in the overall grade for written examinations.

12. Exercise slip (Übungstestat / ÜT)
An exercise slip is awarded once a student has successfully solved the written theory tasks set by the examiner and has demonstrated his or her knowledge of the subject in a colloquium or paper. Colloquia last at least 15 and no more than 45 minutes. The written work must be submitted by a deadline set by the examiner; the latest deadline is the end of the semester in which the class type in question (exercise) was taken.

13. Portfolio examination (Portfolio-Prüfung / PP)
A portfolio exam is a type of exam that consists of a maximum of ten exam items. At least two distinct types of examination should be used for the portfolio examination. The possible forms of examination that can be used result from the forms of examination mentioned in § 14 paragraph 3 APSO-INGI as well as from exercises during the semester. At the beginning of the course, the lecturer determines with which examination elements and with which weighting for the individual examination elements the portfolio examination is to take place. In the case of an examination performance, the individual examination

elements lead to an overall grade for the respective portfolio examination according to their weighting. The overall scope of the portfolio test based on workload and degree of difficulty must not exceed the scope of the type of test if this were selected as the only test element.

14. Take-home examination (Take-Home Prüfung / THP)
A take-home examination consists of the independent processing of one or more specified examination tasks, which is conducted by the student regardless of location with the help of approved aids within the specified processing time. The assignment of the examination tasks and the submission of the solutions are done in electronic form. The processing time is at least 60 and at most 300 minutes. The duration of the examination consists of the processing time and the time that is given to the students for the creation and downloading and uploading of the examination documents. The examination takes place via the software, collaboration, video conferencing systems or learning platforms provided by the university. Before the examination, the students should be given the opportunity to familiarize themselves with the software, collaboration, video conferencing systems or learning platforms. When submitting the work, the student assures in writing or in electronic form that they have written the work independently, within the specified processing time and using no other than the permitted aids specified.

Module Descriptions

Bachelor Information Engineering	
Mathematics 1	
Abbreviation	MA1 / MAE1
Module responsibility	Prof. Dr. Heß (Hess)
Duration / Semester/ Regular cycle	One semester / 1. semester / summer and winter semester
Credits (CP) / Semester hours per week (SHW)	8 LP 5 + 1 SHW
Workload	Attendance: 102 h Self-study: 138 h
Type of module	Mandatory module
Prerequisites	Recommended: Mathematics on secondary school level
Language	English
Learning outcomes	The students can solve mathematical problems for further subjects of the course by using profound knowledge in the fields of • Logic, sets, single argument functions, mathematical induction • Natural, integer, rational, real and complex numbers • Sequences, series and power series • Differential calculus, polynomials, rational functions and curve sketching • System of linear equations, matrices, determinants, eigen-values and -vectors
Learning content	This unit presents an introduction to the fundamentals of Differential Calculus for single argument functions and to linear algebra. Many applications and solution techniques are presented
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K) (PL) Further possible examination types: oral exam (M) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (ÜT)(PVL)
Courses	MA1 (Lecture) MAE1 (Exercises)
Type of Media	MA1: Tuition in seminars, blackboard, slides, computer simulation MAE1: Practical course
Literature	In the current edition: • Lecture notes • Courant, R.; John, F.: Introduction to Calculus and Analysis, Springer • Murray, H.; Protter.: Basic Elements of Real Analysis, Springer

Bachelor Information Engineering	
Software Construction 1	
Abbreviation	SO1 / SOL1
Module responsibility	Prof. Dr. Marc Hensel
Duration / Semester/ Regular cycle	One semester / 1. semester / summer and winter semester
Credits (CP) / Semester hours per week (SHW)	7 LP 4 + 1,5 SHW
Workload	Attendance: 93 h Self-study: 117 h
Type of module	Mandatory module
Prerequisites	Recommended: - school mathematics - basic operation of personal computers (including text editors)
Language	English
Learning outcomes	The students can develop small console applications in the C programming language (e.g., to process scientific data or program microcontrollers) by • analyzing given source code, • implementing given functional requirements, and • implementing, debugging, and testing code in an integrated development environment.
Learning content	• Data types (including integer and floating-point, operators, and type conversions) • Flow control (including selections, jumps, and loops) • Functions (including recursive functions) • Arrays (including 2-dimensional arrays) and strings • Pointers • Memory management (including dynamic memory allocation) • Structures, enumerations, and type definitions • Input / output (including keyboard, console, and files) • Bit operations • Preprocessor directives • Selected applications (like, e.g., sorting, linked lists, and microcontrollers) • Development principles and introduction to an integrated development environment (including coding style and debugging)
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	SO1 (Lecture) SOL1 (Laboratory)

Type of Media	SO1: Tuition in seminars, blackboard, slides, demonstration and elaboration of computer programs SOL1: Laboratory exercises
Literature	In the current edition: • Prata, Stephen: C Primer Plus, Addison Wesley

Bachelor Information Engineering	
Electrical Engineering 1	
Abbreviation	EE1 / EEL1
Module responsibility	Prof. Dr. Rasmus Rettig
Duration / Semester/ Regular cycle	One semester / first semester / summer and winter semester
Credits (CP) / Semester hours per week (SHW)	6 CP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Knowledge of basic calculus (incl. curve sketching, quadratic equations, differential and integral calculus) is recommended
Language	English
Learning outcomes	*By* applying the fundamental concepts and methods (see learning content), the students *can* • calculate, measure and evaluate voltages and currents in basic DC networks with linear and non-linear components, • calculate, measure and evaluate voltages and currents in basic AC networks with capacitors/inductors and sinusoidal excitation to setup electric circuits with defined characteristics.
Learning content	• **Fundamental concepts and methods**: 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, SPICE simulations
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful participation in exercises (LA)(PVL)
Courses	EE1 (Lecture) EEL1 (Practical Course / Laboratory / Exercises)
Type of Media	EE1: Tuition in seminars, blackboard, slides, computer simulation EEL1: Practical course
Literature	In the current edition: • Bongart, T.: Electric Circuits, McGraw-Hill • Edminister, J.: Schaum's Outline of Electric Circuits, McGraw-Hill • Boylestad, R.: Introductory Circuit Analysis, Prentice Hall • Alexander, C.K.: Fundamentals of Electric Circuits, McGraw-Hill

Bachelor Information Engineering	
German	
Abbreviation	GE
Module responsibility	Prof. Dr. Lutz Leutelt
Duration / Semester/ Regular cycle	One semester / 1. semester / summer and winter semester
Credits (CP) / Semester hours per week (SHW)	4 LP 2 SHW
Workload	Attendance: 34 h Self-study: 86 h
Type of module	Mandatory module
Prerequisites	All levels accepted – different courses available
Language	German
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
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Seminar: Successful paper presentation on the basis of written preparation (R)(SL)
Courses	GE (Seminar)
Type of Media	GE: Tuition in seminars, blackboard, slides, computer simulation
Literature	• List of work- and reference books will be provided, Internet Links, Bilingual Dictionary, Hand outs

Bachelor Information Engineering	
Learning and study methods (1)	
Abbreviation	LSE1 / LSL1
Module responsibility	Prof. Dr. Benno Radt
Duration / Semester/ Regular cycle	one semester / 1. semester / summer and winter semester
Credits (CP) / Semester hours per week (SHW)	4 CP 2 + 1.5 SHW
Workload	Attendance: 60 h Self-study: 60 h
Type of module	Mandatory module
Prerequisites	None: Introductory course
Language	English
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
Usability of the module	Degree program Information Engineering Degree program Elektro- und Informationstechnik Degree program Regenerative Energiesysteme und Energiemanament
Requirements for the recognition of credits (Study and exam requirements)	Seminar + Lab: Successful paper presentation on the basis of written preparation (R)(SL)
Courses	LSE1 (Seminar) LSL1 (Lab)
Type of Media	LSE1: Tuition in seminars, blackboard, slides, computer simulation LSL1: Practical course
Literature	In the current issue:

	• 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

Bachelor Information Engineering	
Learning and study methods (2)	
Abbreviation	LSL2
Module responsibility	Prof. Dr. Benno Radt
Duration / Semester/ Regular cycle	One week / 2nd semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	2 LP 1,5 SHW
Workload	Attendance: 25 h Self-study: 35 h
Type of module	Mandatory module
Prerequisites	None: Introductory course
Language	English
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 • can compare skills in project management and development processes with regard to effectiveness from the students' point of view. The analysis is done based on the application example of developing a technical good like for example a robot within several days. The technical good has to fulfill several tasks described in a set of user requirements and user stories. The technical specification and the product realization is developed by the students team enabling them to reflect which theoretical basic knowledge from the courses can be applied to such a project. At the end of the project they know the industry specific glossary typically used in development projects • have become aware of their personal work preferences and learning techniques with regard to life-long learning and interdisciplinary strategies and goals • have the opportunity to contrast and criticize numerous problem solving strategies in their team and the neighboring teams • They reflect on strategies how to complete tasks systematically as well as analyze complex daily situations and set personal and realistic team goals • generate a personalized pattern how to use self-reflection of the individual learning progress and study success with the goal to be effective in a team especially knowing how to profit from multiple technical knowledge pools and multiple personalities in a team
Learning content	• Time management, conflict management and dealing with limited resources • Learning and studying techniques • Group work/ Teamwork/ Group projects/ management techniques; Project management techniques and tools; roles and responsibilities in a team • Reading and communication skills; defining a realistic project scope and S:M:A:R:T goals. • Development Process basics, design thinking process • Presentation skills

Usability of the module	Bachelor Information Engineering Bachelor-Studiengang Elektro- und Informationstechnik
Requirements for the recognition of credits (Study and exam requirements)	Successful direct team assessments by the professors during the ongoing project and successful presentation on the basis of written preparation (R)(SL)
Courses	LSL2 (Practical course)
Type of Media	Seminar: Tuition in seminars, blackboard, slides, data projector, TV/DVD/Video hands on development of a technical good
Literature	In the current issue: • 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 • Jose Maria Delos Santos (2013); Making Things Happen: Mastering Project Management; • Donald G. Reinertsen (2009): The principles of product development flow: second generation lean product development • Isenberg, R. (2005): Lernkonzepte – ein Teilbetrag im Rahmen des Forschungsprojekts wirtschaftliche und technische Adaption der kundenspezifischen Prozesskette im Industrieunternehmen mit Lernkonzepten (Validierung), Berichts-Nr. akp051201b Dezember, HAW Hamburg • Isenberg, R. (2006): Lernprojekt in: Bachelor Kernstudium – didaktische Konzepte (Chancen für den Bachelor), 25ter SRA Workshop HAW-MuP16.1.06 • Klocke, M. (2011): pro8 Studienziel Projektarbeit, 4ING/HRK-Workshop – Kompetenzorientiertes Prüfen in den Ingenieurwissenschaften und der Informatik, Bremen 29.3.2011

Bachelor Information Engineering	
Mathematics 2	
Abbreviation	MA2 / MAE2
Module responsibility	Prof. Dr. Robert Heß (Hess)
Duration / Semester/ Regular cycle	One semester / 2. semester / summer and winter semester
Credits (CP) / Semester hours per week (SHW)	8 LP 5 + 1 SHW
Workload	Attendance: 102 h Self-study: 138 h
Type of module	Mandatory module
Prerequisites	Recommended: Module Mathematics 1
Language	English
Learning outcomes	The students can solve mathematical problems for further subjects of the course by using profound knowledge in the fields of • Integral calculus with applications and integration techniques • Differential equations • Combinatorics, probability theory and stochastics
Learning content	This unit presents an introduction to the fundamentals of integral calculus, multiple argument functions, differential equations and stochastics. Many applications and solution techniques are presented.
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Further possible examination types: oral exam (M) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Exercises: Successful participation in exercises (ÜT)(PVL)
Courses	MA2 (Lecture) MAE2 (Exercises)
Type of Media	MA2: Tuition in seminars, blackboard, slides, computer simulation MAE2: Practical course
Literature	In the current issue: • Lecture notes • Courant, R.; John, F.: Introduction to Calculus and Analysis, Springer • Murray, H.; Protter.: Basic Elements of Real Analysis, Springer

Bachelor Information Engineering	
Software Construction 2	
Abbreviation	SO2 / SOL2
Module responsibility	Prof. Dr. Björn Gottfried
Duration / Semester/ Regular cycle	One semester / 2. semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Software Construction 1
Language	English
Learning outcomes	The students can develop applications with graphical user interfaces (for example, to process and visualize data) by • analysing class structures and source code, • implementing class structures and • implementing applications with given functionality according to given requirements. The students can implement object-oriented concepts, especially for increasing the code quality in the programming language Java.
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.
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	SO2 (Lecture) SOL2 (Laboratory)

Type of Media	SO2: Tuition in seminars, blackboard, slides, demonstration and elaboration of computer programs SOL2: Laboratory exercises
Literature	In the current issue: • Haines, S.; Potts, S.: Java 2 Primer Plus, SAMS Publishing • Flanagan, D.: JAVA in a Nutshell, A Desktop Quick Reference, O'Reilly • Horstmann, C. S.; Cornell, G.: Core Java 2, Volume I-Fundamentals, Sun Microsystems Press • Eckel, B.: Thinking in Java, Prentice Hall • Arnold, K.; Gosling, J.; Holmes, D.: The Java Programming Language, Addison-Wesley

Bachelor Information Engineering	
Electrical Engineering 2	
Abbreviation	EE2 / EEL2
Module responsibility	Prof. Dr. Rasmus Rettig
Duration / Semester/ Regular cycle	One semester / second semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 CP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Electrical Engineering 1
Language	English
Learning outcomes	*By applying* the tools and methods described in the learning content, the students *can* • calculate, measure and evaluate voltages and currents in advanced AC networks with capacitors/inductors and sinusoidal or non-sinusoidal excitation, • calculate, measure and evaluate transient signals in LCR networks, • perform and evaluate AC measurements with the oscilloscope, • can calculate voltages and currents in transformers with sinusoidal excitation, • can calculate voltages and currents in multiphase systems *to* setup electric circuits with defined characteristics.
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
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful participation in exercises (LA)(PVL)
Courses	EE2 (Lecture) EEL2 (Practical Course / Laboratory / Exercises)
Type of Media	EE2: Tuition in seminars, blackboard, slides, computer simulation EEL2: Practical course
Literature	In the current issue: • Bongart, T.: Electric Circuits, McGraw-Hill • Edminister, J.: Schaum's Outline of Electric Circuits, McGraw-Hill • Boylestad, R.: Introductory Circuit Analysis, Prentice Hall • Alexander, C.K.: Fundamentals of Electric Circuits, McGraw-Hill

Bachelor Information Engineering	
Electronics 1	
Abbreviation	EL1 / ELL1
Module responsibility	Prof. Dr. Lapke
Duration / Semester/ Regular cycle	One semester / 2nd semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Electrical Engineering 1 and Mathematics1
Language	English
Learning outcomes	At the conclusion of this module, students are able to • describe the nonlinear behaviour of a diode by means of mathematical formulas, characteristic parameters and characteristic curves, characterise diodes by measurement and design rectifier circuits to generate DC voltages. • describe the non-linear behaviour of bipolar and JFET/MOSFET transistors by means of mathematical formulas, characteristic parameters and characteristic curves; measure and evaluate characteristic curves with suitable equipment to the end of designing amplifier circuits; use transistors as a switch and constant current source • work on technical problems in a team in order to successfully complete the tasks set in the lab practical by applying standard engineering methods
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
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful participation in exercises (LA)(PVL)
Courses	EL1 (Lecture) ELL1 (Laboratory)

Type of Media	El1: Tuition in seminars, blackboard, slides, computer simulation ELL1: Practical course
Literature	In the current issue: • Tietze, U.; Schenk, C. (2008): Electronic Circuits: Handbook for Design and Application, Springer Publishing

Bachelor Information Engineering	
Intercultural Competence	
Abbreviation	IC
Module responsibility	Prof. Dr. Lapke
Duration / Semester / regular cycle	One semestzer / 2nd semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	3 LP 2 SHW
Workload	Attendance: 34 h Self-study: 56 h
Type of module	Mandatory module
Prerequisites	Recommended: German course of 1st semester
Language	German and/or English
Learning outcomes	At the conclusion of this module, students are able to apply their understanding of cultural differences to effective work and collaboration in international teams and to their approach to the challenges of everyday life in Germany. Specifically, they • are familiar with various aspects and examples of cultural differences • are conscious of the importance of cultural awareness to success at work and in everyday life • have attained a critically reflective awareness of culture • have improved their proficiency in German and/or English • have advanced their ability to communicate effectively in intercultural situations.
Learning content	• Theory of cultural differences in communicative practices, taking into account both verbal and non-verbal communication • Intercultural issues in business and team-building • Intercultural aspects of life in Germany • Development of practical skills in group work, incorporating blended learning (intercultural group work and language learning via electronic platforms) • The class will take place, at least in part, in German, in line with participants' language preferences and proficiency.
Usability of the module	• Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful paper presentation on the basis of written preparation (R)(SL)
Courses	IC (Lecture)
Type of Media	Lecture: Tuition in seminars, blackboard, slides, TV/DVD/Video

Literature	In the current issue: • 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

<table>
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<tr><th colspan="2">Signals and Systems 1</th></tr>
<tr><td>Module number</td><td>SS1 / SSL1</td></tr>
<tr><td>Module coordination</td><td>Prof. Dr. Michael Erhard</td></tr>
<tr><td>Duration/ semester/ frequency</td><td>One semester / 3. semester / winter and summer semester</td></tr>
<tr><td>Credits (CP) /
Semester hours per week (SHW)</td><td>6 LP
3 + 1 SHW</td></tr>
<tr><td>Workload</td><td>attendance: 68 h
self-study: 112 h</td></tr>
<tr><td>Type of module</td><td>Mandatory</td></tr>
<tr><td>Prerequisites</td><td>Recommended: Mathematics 1 and 2</td></tr>
<tr><td>Language</td><td>English</td></tr>
<tr><td>Learning outcomes</td><td>The students
know both the Fourier- and Laplace-transform,
understand basic properties of signals and systems,
can describe continuous-time signals in the time, Laplace and frequency domain,
can describe continuous-time, linear, time-invariant systems (LTI-systems) in the time, Laplace and frequency domain,
can calculate the output signal of a continuous-time LTI-system for an arbitrary input signal,
are familiar with the basic types of continuous-time, frequency-selective filters and the transmission properties of LTI-systems.</td></tr>
<tr><td>Learning content</td><td>Introduction to Fourier- and Laplace transformation
Continuous-time signals in the time, Laplace and frequency domain
Basic system properties: linearity, time-invariance, stability and causality
Description of continuous-time LTI-systems in the time, Laplace and frequency domain: convolution, differential equation, impulse and step response, transfer function, frequency response
Analysis of output signals from arbitrary input signals transmitted via continuous-time LTI-systems
Basic types of continuous-time, frequency-selective filters and the transmission properties of LTI-systems</td></tr>
<tr><td>Usability of the module</td><td>Degree program relevance</td></tr>
<tr><td>Requirements for the recognition of credits
(Study and exam requirements)</td><td>Regular examination type for module testing:
Lecture: Successful passing in written exam (K)(PL)
Laboratory: Successful participation in exercises (LA)(PVL)</td></tr>
<tr><td>Courses</td><td>SS1 (lecture)
SSL1 (laboratory)</td></tr>
<tr><td>Teaching methods</td><td>SS1: instruction in seminars, blackboard, slides, computer simulation
SSL1: practical tuition</td></tr>
<tr><td>Literature</td><td>In the current issue:
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): Continuous and Discrete Signals and Systems, Prentice Hall</td></tr>
</table>

Bachelor Information Engineering	
Algorithms and Data Structures	
Abbreviation	AD / ADL
Module responsibility	Prof. Dr. Dierks
Duration / Semester/ Regular cycle	One semester / 3rd semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Programming experience recommended
Language	English
Learning outcomes	• The students understand that choosing data structures and algorithms affects the efficiency of their programs • The students know state-of-the-art solutions for typical problems and they are able to apply them in their own programs to improve the quality thereof. • The students know theoretical limits of sorting and searching and they are able to apply this knowledge to analyze the complexity of new programming problems • The students are able to synthesize efficient programs by applying the taught algorithms and data structures • The students learn that it makes sense to apply state-of-the-art algorithms to produce competitive software that is scalable
Learning content	**Lecture:** • Introduction with elementary algorithms and complexity estimations, complexity • Abstract data types and their implementation • Sorting, Divide-and-Conquer, Pivot, Mergesort, Priority Queue • Search algorithms • Finite-state automata • 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
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Further possible examination types: oral exam (M), paper (R) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)

Courses	AD (Lecture) ADL (Laboratory / Exercises)
Type of Media	AD: Tuition in seminars, blackboard, slides, computer simulation ADL: Practical course
Literature	In the current issue: • Sedgewick, R.: Algorithms, Addison-Wesley • Hopcroft, J.; Motwani, R.; Ullman, J.: Introduction to Automata Theory, Languages and Computation, Addison-Wesley

Bachelor Information Engineering	
Electronics 2	
Abbreviation	EL2 / ELL2
Module responsibility	Prof. Dr. Martin Lapke
Duration / Semester/ Regular cycle	One semester / 3rd semester / academic year
Credits (CP) / Semester hours per week (SHW)	7 LP 4 + 1,5 SHW
Workload	Attendance: 93 h Self-study: 117 h
Type of module	Mandatory module
Prerequisites	Recommended: Electrical engineering 1+2 and Electronics 1
Language	English
Learning outcomes	At the conclusion of this module, students: **Analogue electronics** • are able, drawing on their knowledge of the characteristics of bipolar transistors, to design and build a differential amplifier with the aim of understanding the fundamental properties of operational amplifiers • are able to characterise operational amplifiers by means of mathematical formulas and measurement, • are able to design and implement basic operational amplifier circuits using the virtual short circuit concept and via this to understand and build amplifier circuits and active filters. **Digital electronics** • are familiar with the internal structure of digital circuits of modern transistor-family circuit families and can analyse these circuits in terms of inputs, outputs and internal processing, as well as classifying their main parameters given in datasheets • are able to classify AD/DA converters by their characteristics and the principal parameters given in datasheets to the end of designing and implementing simple converters • are able to simulate and measure simple digital circuits. **General** • are able to apply an engineering-appropriate, team-based method of working to a technical problem in the context of the group laboratory tasks set.
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 • **Digital Electronics**: Overview of digital circuit families: characteristic values, characteristic curves • **DA/AD converters:** digital to analog converter, analog to digital converter: parameters, circuit principles, comparisons and applications subject to modifications and amendments in light of recent events
Usability of the module	Degree program relevance

Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful participation in exercises (LA)(PVL)
Courses	EL2 (Lecture) ELL2 (Laboratory)
Type of Media	EL2: Tuition in seminars, blackboard, slides, computer simulation ELL2: Practical course
Literature	In the current issue: • Tietze, U.; Schenk, C. (2008): Electronic Circuits: Handbook for Design and Application, Springer Publishing • Ayers, J.E. (2010): Digital Integrated Circuits, 2nd Edition, Tayler & Francis Verlag • Maloberti, F. (2010): Data Converters, Springer Verlag • Kester, W. (2005): Data Conversion Handbook, Analog Devices Verlag

Bachelor Information Engineering	
Digital Circuits	
Abbreviation	DI / DIL
Module responsibility	Prof. Dr. Lutz Leutelt
Duration / Semester/ Regular cycle	one semester / 3rd semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Mathematics 1, Software Construction 1, Electrical Engineering 1 + 2
Language	English
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 assess logical and timing relations within digital circuits and to draw correct consequences for an optimum circuit design, • have the ability to analyse 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, in order to design, realize and verify a digital logic based solution for a given technical problem and its requirements.
Learning content	• polyadic number systems and codes, including their arithmetical operations in digital domain • the meaning of twos complement for digital circuits and computer architecture, including basic arithmetic operations • Boolean algebra • 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 modelling of simple circuits with MSI complexity on register transfer level (RTL), also using symbolic delays • analysis and HDL modelling of special digital circuit outputs • synthesis of combinational logic for programmable circuits • different digital output circuits (push-pull, open drain, tri-state) • introduction into structure and design of Mealy- and Moore- state machines using state diagrams, state tables, including HDL modeling • structure, behaviour and HDL modelling of state- and edge- driven latches and flipflops, metastability • structure, design and HDL modelling of controlled counters and shift registers • a HDL coding style which assures identical simulation and synthesis semantics
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R), home project (H), portfolio examination (PP) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	DI (Lecture) DIL (Laboratory / Exercises)
Type of Media	DI: Tuition in seminars, blackboard, slides, computer simulation DIL: Practical course
Literature	In the current issue: • Wakerly, J.F.: Digital Design Principles & Practices, Prentice Hall • Chu, P.P.: RTL Hardware Design Using VHDL (Coding for Efficiency, Portability, and Scalability), John Wiley & Sons • Armstrong, J.R.; Gray, F.G.: VHDL-Design. Representation and Synthesis, Prentice Hall • Brown, S.; Vranesic, Z.: Fundamentals of Digital Logic with VHDL Design, Mc Graw Hill • Reichardt, J.: Lehrbuch Digitaltechnik, Oldenbourg Verlag

Bachelor Information Engineering	
Economics and Management	
Abbreviation	EM / EME
Module responsibility	Prof. Dr. Jörg Dahlkemper
Duration / Semester/ Regular cycle	One semester / 3rd semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	-
Language	English
Learning outcomes	The students • understand general management principles and can apply commonly used management tools in companies like SWOT analysis to derive strategic options in a case study and Balanced Scorecard to monitor the achievement of strategic goals • understand cost concepts with the focus on engineering costs and terms related to investment to judge its attractiveness • have the ability to apply methods of investment analysis to evaluate projects, • have the ability to set up a business work out and present business opportunities.
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
Usability of the module	Bachelor Information Engineering Bachelor Regenerative Energiesysteme und Energiemanagement
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful paper presentation on the basis of written preparation (R)(PVL)
Courses	EM (Lecture) EME (Exercises, Case study)
Type of Media	EM: Tuition in seminars, blackboard, slides, computer simulation EME: Case study, literature
Literature	In the current issue: • Sullivan, W. G.; Wicks, E. M.; Koelling, C. P.: Engineering Economy. Pearson. • Newman, D.G. et al.: Engineering Economic Analysis. Oxford University Press • Junge, P.: BWL für Ingenieure. Gabler Verlag

Bachelor Information Engineering	
Signals and Systems 2	
Module number	SS2 / SSL2
Module coordination	Prof. Dr. Michael Erhard
Duration/ semester/ frequency	One semester / 4. semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	attendance: 68 h self-study: 112 h
Type of module	Mandatory
Prerequisites	Recommended: Signals and Systems 1
Language	English
Learning outcomes	The students • know both the discrete and the time-discrete Fourier- and z-transform, • understand basic properties of time-discrete signals and systems, • can describe time-discrete signals in the time, Laplace and frequency domain, • can describe time-discrete, linear, time-invariant systems (LTI-systems) in the time, Laplace and frequency domain, • are familiar with the basic types of time-discrete, frequency-selective filters and master simple layout techniques. • can describe stochastic signals in the time and frequency domain, • are familiar with the basic concepts of the analysis of stochastic signals.
Learning content	• Introduction to discrete Fourier- and z-transformation • Transformation between continuous and discrete signals: sampling, signal reconstruction, sampling theorem • Time-discrete signals in the time, Laplace and frequency domain • Description of time-discrete LTI-systems in the time, Laplace and frequency domain: discrete convolution, difference equation, impulse and step response, transfer function, frequency response • Basic types of time-discrete, frequency-selective filters • Stochastic signals: noise, power-density spectrum, auto-correlation-function, cross-correlation-function, transmission of stochastic signals via LTI-systems
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful participation in exercises (LA)(PVL)
Courses	SS2 (lecture) SSL2 (laboratory)
Teaching methods	SS2: instruction in seminars, blackboard, slides, computer simulation SSL2: practical tuition
Literature	In the current issue: • Oppenheim, A.; Willsky, A.: Signals and Systems, Prentice Hall • Strum, R.; Kirk, D.: Contemporary Linear Systems Using Matlab, Brooks Cole Pub

	• Lee, E.; Varaiya, P.: Structure and Interpretation of Signals and Systems, Addison Wesley • Ziemer, R.: Continuous and Discrete Signals and Systems, Prentice Hall

Bachelor Information Engineering	
Software Engineering	
Abbreviation	SE / SEL
Module responsibility	Prof. Dr. Kolja Eger
Duration / Semester/ Regular cycle	One semester / 4. semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Software Construction 2
Language	English
Learning outcomes	The student systematically crafts useful, reliable, and maintainable software – by • elaborating customer needs and transforming these into requirements, • modeling the structure and time-behavior of object-oriented software, and • testing software to fulfill technical requirements and user needs.
Learning content	• Basic ideas of the software engineering process (including analysis, design, realization, and test), process models, and modelling using UML (Unified Modelling Language) • Requirement analysis and use case studies • Modelling by selected UML diagrams (e.g., class, object, activity, state machine, sequence, and/or communication diagrams) based on requirements • Introduction to a software engineering tool • Construction of object-oriented software for small applications using software engineering methods (e.g., selected design patterns)
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Further possible examination types: oral exam (M), paper (R), project (Pj), (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	SE (Lecture) SEL (Laboratory / Exercises)
Type of Media	SE: Tuition in seminars, blackboard, slides, computer simulation SEL: Practical course
Literature	In the current issue: • Booch, G.; Rumbaugh, J.; Jacobson, I.: The Unified Modeling Language User Guide, Addison-Wesley • Douglass, B.P.: Real Time UML: Advances in the UML for Real-Time Systems, Addison-Wesley • Rumbaugh, J.; Jacobson, I.; Booch, G.: The Unified Modeling Language Reference Manual, Addison-Wesley • Sommerville, I.: Software Engineering, Addison-Wesley

Bachelor Information Engineering	
Microcontrollers	
Abbreviation	MC / MCL
Module responsibility	Prof. Dr. Paweł Adam Buczek
Duration / Semester/ Regular cycle	One semester / 4th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	7 LP 4 + 1,5 SHW
Workload	Attendance: 93 h Self-study: 117 h
Type of module	Mandatory module
Prerequisites	Recommended: Software Construction 1 and 2, Digital Circuits, good proficiency in programming in C and digital logic/arithmetic, fundamentals of digital hardware
Language	English
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: ○ general purpose input/output ports

	○ serial interfaces ○ digital to analog converters and analog to digital converters ○ timer • basic concepts of subroutines, exceptions and interrupts • exceptions and interrupts as method to deal with asynchronous events • hard- and software mechanisms 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
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R), home project (H), portfolio examination (PP) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	MC (Lecture) MCL (Laboratory / Exercises)
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation, lab development equipment Laboratory: Practical course in a lab with actual microcontrollers
Literature	In the current issue: • 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

Bachelor Information Engineering	
Digital Systems	
Abbreviation	DS / DSL
Module responsibility	Prof. Dr. Lutz Leutelt
Duration / Semester/ Regular cycle	one semester / 4th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Digital Circuits
Language	English
Learning outcomes	The students • have the ability to design finite 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 in order to design, implement and evaluate a complex digital system solution with programmable logic for a given technical problem and its requirements.
Learning content	• A Register-Transfer (RT-) –level based HDL-coding style which is targeted for synthesis, including suitable datatypes and the design of test benches • A CAE based design method for FPGAs, including critical path analysis and performing post-layout timing simulations • Design and modeling of finite 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 flip flops, 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

Usability of the module	Bachelor Information Engineering Bachelor Elektrotechnik und Informationstechnik Bachelor Mechatronik
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R), home project (H), portfolio examination (PP) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	DS (Lecture) DSL (Laboratory / Exercises)
Type of Media	DS: Tuition in seminars, blackboard, slides, computer simulation DSL: Practical course
Literature	In the current issue: • Chu, P.P.: RTL Hardware Design Using VHDL (Coding for Efficiency, Portability, and Scalability), John Wiley & Sons • Wakerly, J.F.: Digital Design Principles & Practices, Prentice Hall • Jasinski, R.: Effective Coding with VHDL, MIT Press • Armstrong, J.R.; Gray, F.G.: VHDL-Design. Representation and Synthesis, Prentice Hall • Brown, S.; Vranesic, Z.: Fundamentals of Digital Logic with VHDL Design, Mc Graw Hill • Reichardt, J.: Lehrbuch Digitaltechnik, Oldenbourg Verlag

Bachelor Information Engineering	
Databases	
Abbreviation	DB / DBL
Module responsibility	Prof. Dr. Ulrike Herster
Duration / Semester/ Regular cycle	One semester / 4. semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Software Construction 1, Software Construction 2
Language	English
Learning outcomes	Students understand and apply methods and techniques for developing database applications by • understanding the concepts of databases, • using database management systems, • modelling the application's structure and behaviour with entity relationship diagrams and relational models, • optimizing the relational database design, and • inserting, modifying, deleting, and querying data in the database using the Structured Query Language (SQL).
Learning content	• Basics of databases and database management systems • Entity relationship diagrams • Relational model • Constraints • Normalization • Algebra of Relations • Structured Query Language • Views • Transactions • Triggers
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R), portfolio examination (PP) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)

Courses	DB (Lecture) DBL (Laboratory / Exercises)
Type of Media	DB: Tuition in seminars, blackboard, slides, computer simulation DBL: Practical course
Literature	In the current issue: • R. Elmasri, S.B. Navathe: Fundamentals of Database Systems, Prentice Hall • Elmasri: Database System Concepts and Architecture • Date: An Introduction to Database Systems, Pearson • Date: SQL and Relational Theory: How to write accurate code, O'Reilly and Associates • Feuerstein, S. and Pribly, B.: Oracle PL/SQL Programming, O'Reilly and Associates • Lemahieu, W. et al.: Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data, Cambridge University Press • Gillenson, M.: Fundamentals of Database Management Systems, Wiley

Bachelor Information Engineering	
Scientific and project work	
Abbreviation	SP
Module responsibility	Prof. Dr. Lapke
Duration / Semester/ Regular cycle	Block seminar / 6th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	4 LP 2 SHW
Workload	Attendance: 34 h Self-study: 86 h
Type of module	Mandatory module
Prerequisites	-
Language	English
Learning outcomes	At the conclusion of this module, students: - are able to structure the findings and results of their project and other work and communicate them to others in presentations, and to write their bachelor thesis using correct, appropriate methods - know the fundamental principles of project management and can use them for the purpose of planning and efficiently realising small- to medium-size projects
Learning content	- Writing of scientific papers, methodically preparing the Bachelor thesis - Scientific principles - Analysis of source material, working with literature and references (investigation, online literature searches, rules and styles for referencing) - Working in teams group project work - Fundamental principles of project management - Conflict management - A small technical or non-technical task for the purpose of practising project work
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Lecture: Successful passing in oral presentations and written report (R) (PL)
Courses	SP (Lecture)
Type of Media	Lecture: Tuition in seminars, blackboard, slides, computer simulation
Literature	In the current issue: • 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

Bachelor Information Engineering	
Internship with Colloquium	
Abbreviation	IP / IPP
Module responsibility	Praktikumsbeauftragte(r)
Duration / Semester/ Regular cycle	One semester / 5^{th} semester / academic year
Credits (CP) / Semester hours per week (SHW)	20 + 5 LP 20 Wochen
Workload	Präsenzstudium: 51 Praktikumszeit: 20 Wochen entsprechend 699 Stunden
Type of module	Mandatory module
Prerequisites	In principle, the practical semester can only begin once the first year of study has been successfully completed.
Language	English or German
Learning outcomes	Knowledge and methodological skills: In this component of the degree course, students expand their subject knowledge primarily via self-study and advance their team working skills and key competencies in the context of their developing professional identity as an engineer. The practical semester serves to give students the opportunity to use the knowledge and skills attained during their degree course to date in an industrial/business setting and to familiarise themselves with the challenges and expectations an engineer encounters as an employee of a business or organisation. It teaches students to make appropriate assessments of the complexities of problems and tasks encountered in industry and deploy the knowledge and problem-solving skills acquired during their degree course to meet these challenges. It has the further purpose of familiarising students with the structures and processes of businesses and organisations typical of their field and enabling them to contextualise their future tasks and roles in the research, development and project activities that take place in that business or organisation. At the conclusion of their practical semester, we expect students to have learned about the overarching contextual issues and conditions that an engineer encounters in her work, the current state of technology in their future career field, and the legal regulations, norms and standards relevant to that field, including their influence on the task or tasks completed during the practical semester. Interpersonal competencies and key skills: During their practical semester, students learn about: - formulating transdisciplinary problems and tasks - coordinating sub-tasks within an overarching task or project - managing members of a team - recognising and defining areas of intersection among disciplines in the context of a project with an interdisciplinary/transdisciplinary character

	- analysing and assessing an engineering-based solution to a problem, including its economic/business aspects; bringing non-engineers within the company's staff on board in working towards the appropriate solution Students learn the formal rules and informal norms governing the manner in which the staff of a business or organisation work together and become able to assess their influence on the business' or organisation's success. Students experience international settings and/or interconnections between businesses/organisations and the globalised world, enabling them to identify the knowledge and skills they will require in order to work in this type of setting after graduation. The practical semester enables students to recognise the importance of being a team player and to identify and realistically assess their individual strengths and weaknesses in a professional/work context.
Learning content	The required period of practical experience is 20 weeks. Students complete a task/problem in line with the outcomes listed above and agreed upon on an individual basis by the business or organisation in which they are completing their practical semester and an appropriate professor of HAW Hamburg.
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Internship: attendance confirmed by the company Colloquium: Internship report and presentation (SL)
Courses	IP (Internship) IPP (Colloquium)
Type of Media	IP: Internship IPP: Report and presentation
Literature	-

Bachelor Information Engineering	
Bussystems and Sensors	
Abbreviation	BU / BUL
Module responsibility	Prof. Dr. Paweł Adam Buczek
Duration / Semester/ Regular cycle	One semester / 6th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Electronics 1 and 2, Microcontrollers
Language	English
Learning outcomes	The students can • choose the proper sensor in order to implement specific measurement application • have the knowledge of circuits of processing of sensor signals, in order to read out the sensor signal • have the knowledge of characteristics of bus systems and of requirements for bus systems, in order to plan the communication network of a distributed system • analyze, develop, and check important components of circuits for the processing of sensor signals in order to include the sensors in larger applications • define requirements for linking solutions and to choose bus systems for the realization and integrate electronic devices into bus systems, in order to devise distributed measurement 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, I²C) • The right to chance and add actual topics is reserved
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R), home project (H), portfolio examination (PP) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	BU (Lecture) BUL (Laboratory / Exercises)

Type of Media	BU: Tuition in seminars, blackboard, slides, computer simulation BUL: Practical course in a laboratory
Literature	In the current issue: • 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 bus systems

Bachelor Information Engineering	
Operating Systems	
Abbreviation	OS / OSL
Module responsibility	Prof. Dr.-Ing. Holger Gräßner
Duration / Semester/ Regular cycle	One semester / 6th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 CP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Programming knowledge required. Microprocessor knowledge recommended.
Language	English
Learning outcomes	The students • know the basic properties and functionalities of operating systems and • know the most common available operating systems. The students can • use the functionalities of a given operating system to realize specific programming tasks, • design and implement complex systems by making use of an operating system.
Learning content	• Multitasking, threads and processes, • Communication and synchronization, • Ressource allocation and timing, • Interaction with external signals, • Input-/Output programming (e. g. in C), • Current topics regarding operating systems, • Lab tasks to gain deeper knowledge using typical applications.
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K)(PL) Further possible examination types: oral exam (M), paper (R), portfolio examination (PP) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	OS (Lecture) OSL (Laboratory / Exercises)
Type of Media	OS: Tuition in seminars, blackboard, slides, computer simulation OSL: Practical course
Literature	In the current issue: • Stallings, W.: Operating systems, internals and design principles.

	• Tanenbaum, A. S.: Modern operating systems. • Kernighan, B. W.; Ritchie, D. M.: The C programming language. • Kerrisk, M.: The Linux Programming Interface. • Manuals of the operating systems discussed in the lecture.

Bachelor Information Engineering	
Digital Signal Processing	
Abbreviation	DP / DPL
Module responsibility	Prof. Dr. Ulrich Sauvagerd
Duration / Semester/ Regular cycle	One semester / 6. semester / offered during summer semester only
Credits (CP) / Semester hours per week (SHW)	6 CP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Profound knowledge in theory of complex numbers (MA1 and MA2) Continuous and discrete signals and systems theory (SS1 and SS2) ANSI C programming (SO1), MATLAB
Language	English
Learning outcomes	The students know (knowledge) • the typical set-up of a DSP-system and its key components • and understand basic techniques of digital signal processing and how to realize real-time DSP-programs can (skills) • analyze typical problems arising in digital signal processing and work out proposals for the solution • use MATLAB for the simulation of algorithms • implement these algorithms using ANSI C programs on a DSP for real-time signal processing • design digital filters • carry out spectral analysis using DFT/FFT and judge the measurement results are competent/capable • to analyse and judge typical problems arising in the field of digital signal processing and create solutions
Learning content	**Lecture (3 SWS)** Introduction into • Development methods for a discrete-time system • Simulation tools MATLAB/ Simulink • DSP-architectures • real-time DSP-development systems Basics of digital signal processing • Sampling and reconstruction of a continuous-time signal • number representation • overflow- and round-off errors • limit cycles • Convolution Discrete Fourier-transformation • Frequency- and amplitude resolution • Windowing • Fast Fourier Transform (FFT) Filter design

	• Window techniques • Computer-aided filter designs • Impulse invariant method • Bilinear-Transformation **Laboratory (1 SWS)** • Working with Matlab/Simulink • Working with a real-time DSP-development system • Simulations and DSP implementations of FIR Filters • Simulations and DSP implementations of IIR Filters • Simulations and DSP implementations of Fast-Fourier Transforms
Usability of the module	Degree program relevance
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written exam (K)(PL) Laboratory: Successful participation in exercises (LA)(PVL) Further possible examination types: oral exam, presentation (paper) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course.
Courses	DP (Lecture) DPL (Laboratory)
Type of Media	DP: Tuition in seminars, blackboard, slides, computer simulation DPL: Practical course
Literature	In the current issue: • Oppenheim, Schafer: Discrete-time signal processing, Pearson • Manolakis, Proakis: Digital Signal Processing, Pearson, 2013 • Tretter, Steven A.: Communication System Design Using DSP, Algorithms, Springer, 2008 • Mitra, S.K.: Digital Signal Processing: A Computer Based Approach, McGraw-Hill, 2000 • R.Chassaing: Digital Signal Processing and Applications with TMS320C6713, Wiley, 2010 • Gerdsen, Kröger: Digitale Signalverarbeitung in der Nachrichtenübertragung, Springer, 1997

Bachelor Information Engineering	
Digital Communication Systems	
Abbreviation	DC / DCL
Module responsibility	Prof. Dr. R. Schoenen
Duration / Semester/ Regular cycle	One semester / 6. semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	6 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 112 h
Type of module	Mandatory module
Prerequisites	Recommended: Adequate knowledge of mathematics, signals and systems
Language	English
Learning outcomes	The students • understand the structure and context of digital communication systems (ISO/OSI layers 1 and 2), • are able to split a complete system into suitable known system blocks, • are able to describe the main properties of these blocks and to define the block requirements with respect to a given application, • are able to describe the behavior of the blocks by mathematical equations, • have the knowledge and ability to apply basic measurement techniques.
Learning content	Lecture: • system blocks and context in the ISO/OSI reference model • digitizing and reconstruction of analog signals • random signals in time and frequency domain • source coding and information theory • distortionless digital signal transmission and channel models • channel equalization and clock recovery • disturbed signals by noise and interference • bit error ratio for AWGN-channels and channel coding • digital modulation, link budget calculus and Shannon capacity limit • medium access control (e.g., multiple access, ARQ) • modern radio communication systems (e.g., software-defined radio) Changes and additions due to actual occasions reserved Laboratory: • set parameters and verification of digital systems hardware blocks • implementation and test of a complete transmission system • examples of hardware blocks: A/D converter and interpolation filters, correlative encoder/decoder, equalizer, OOK/FSK-modulator/demodulator Other topics of the lecture are also possible
Usability of the module	Degree program relevance

Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K) (PL) Further possible examination types: oral exam (M), paper (R) (PL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA)(PVL)
Courses	DC (Lecture) DCL (Laboratory / Exercises)
Type of Media	DC: Tuition in seminars, blackboard, slides, computer simulation DCL: Lab exercises and computer simulations
Literature	In the current issue: • Gerdsen, P.: Digitale Nachrichtenübertragung, Teubner Verlag • Sklar, B.: Digital Communications Fundamentals and Applications, PrenticeHall • Proakis, J.: Digital Communications, McGraw-Hill

Bachelor Information Engineering	
Elective Project 1	
Abbreviation	CJ1
Module responsibility	Prof. Jörg Dahlkemper
Duration / Semester/ Regular cycle	One semester / 5th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	5 LP 3 SHW
Workload	Attendance: 51 h Self-study: 99 h
Type of module	Mandatory module
Prerequisites	-
Language	English or German
Learning outcomes	The students • know how to explore a subject of Information Engineering at greater depth by finding literature and acquisition of the required theoretical and practical knowledge to solve a technical problem, • know how to organize the given subject by applying methods of project management to achieve the goal in an efficient manner, • know how to manage a project and to organize teams to fulfil the given task with efficiently and effectively, • can apply methods during the project preparation phase to foresee and avoid typical mistakes in the very early project phase, • apply methods to manage complexity and uncertainty in projects to act in a professional manner in an industrial context, • can handle conflicts within the team or with the customer and improve social competencies by independent and responsible work attitude to achieve an optimum result with a team.
Learning content	• The team has to explore a subject of Information Engineering organized as project. Typical examples are hardware or software development projects, simulations, the systematic analysis and interpretation of measurement data or theoretical work. Either the project team or the lecture proposes the subject. • Project teams must consist of 3, 4 or 5 members. A number of 4 teammates is considered to be ideal. Only in exceptional duly justified cases the number of teammates it is allowed to deviate from the regulation. The team agrees the times of presence with the lecturer. In case of geographically distributed teams the appropriate communication procedure is to be agreed within the team including the lecturer to enable an efficient work flow. • The subject must be demanding enough so that the achievement of the project goal requires a good cooperation within the team. The workload of each person must meet the module workload and must respect the fact that the project is intended to be run simultaneously to the internship. • The project requires a final project presentation and a written project report. The students must specify who contributed to which part of the project report.
Usability of the module	Bachelor Information Engineering Bachelor Elektro- und Informationstechnik Bachelor Regenerative Energiesysteme und Energiemanagement
Requirements for the recognition of credits (Study and exam requirements)	Project: Successful participation in the project with task completion and quality of results and a written report (Pj)(SL)

Courses	CJ1 (Project)
Type of Media	CJ1: literature, internet, working independently in the project within a team
Literature	Depends on project

Bachelor Information Engineering	
Elective Course 1	
Abbreviation	CM1 / CML1
Module responsibility	Studiengangsleiter*in
Duration / Semester/ Regular cycle	One semester / 7th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	5 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 82 h
Type of module	Mandatory module
Prerequisites	Elective modules deal with advanced content in higher semesters And build up on knowledge of the first year of study and the second year of study. The students receive one at the beginning of each semester a description of the elective modules for the coming semester, event-specific requirements and required prior knowledge.
Language	English
Learning outcomes	Required elective modules have the purpose of enabling students to expand and extend their knowledge of fundamental principles of their field and/or specialise in an area of information engineering's application, such as alternative/renewable energy sources, climate-friendly applications, autonomous driving systems, smart home technologies, machine learning and wireless communication. Engineering-related skills At the conclusion of this module, students are able to - use the knowledge of STEM subjects (such as physics and electronics) acquired in the course of their degrees to date in tackling applied problems and tasks in electrical engineering - distinguish key subfield-specific terms, approaches and points of view from one another and understand their significance - comprehend the underlying electrical engineering problems associated with solutions in a specific field of application - take into account specific requirements for electrical engineering solutions in a particular field of application - correctly contextualise specific requirements of and approaches to solutions in the field (e.g. in relation to areas of work such as R&D, technical aftercare, management accounting, product approval and quality management) Methodological skills At the conclusion of this module, students are able to - apply methods and approaches from the general field of engineering (such as elements of good scientific practice) to problems from a specific field of application - assess the benefits and drawbacks of specific approaches to solving a problem from the relevant subfield and apply this assessment in (for example) practice tasks - follow specialist discourse (e.g. at conferences, in scientific periodicals or for a), engaging actively in the discourse where appropriate

	Interpersonal skills (communication and cooperation) At the conclusion of this module, students are able to - understand and reflect on the interdisciplinary character of electrical engineering, particularly in its interactions with related disciplines such as mechanical engineering and computer science - present solutions they have designed themselves to others and respond constructively to criticism and suggestions for improvement Professional competencies (scientific identity, professional actions) At the conclusion of this module, students: - have a more realistic idea of engineering as a field of work and greater clarity on potential directions for their future careers
Learning content	The specific content of the module is dependent on the student's individual choice. Students can access descriptions of currently available required elective modules on their degree course's website prior to the commencement of each semester
Usability of the module	The elective module serves to deepen the basics and/or specialization in an application area of information technology. The knowledge acquired so far should be used as widely as possible and elaborated in relation to the area of specialization. The module prepares for the complexity of tasks in the practical semester and in the bachelor thesis. In addition, the students come into contact with possible professional fields. (Scientific and technical courses can also be used other courses at HAW Hamburg or at other universities be chosen, provided that these are compatible with the objectives of the course to match. The latter requires the prior consent of the subject advisor and approval by the examination board.)
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K), oral exam (M), paper (R) (PL) The examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA) or paper (R) (PVL)
Courses	CM1 (Lecture) CML1 (Laboratory / Exercises)
Type of Media	CM1: Tuition in seminars, blackboard, slides, computer simulation CML1: Laboratory- and computerpractical course
Literature	see the respective elective module description

Bachelor Information Engineering	
Elective Course 2	
Abbreviation	CM2 / CML2
Module responsibility	Studiengangsleiter*in
Duration / Semester/ Regular cycle	One semester / 7th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	5 LP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 82 h
Type of module	Mandatory module
Prerequisites	Elective modules deal with advanced content in higher semesters And build up on knowledge of the first year of study and the second year of study. The students receive one at the beginning of each semester a description of the elective modules for the coming semester, event-specific requirements and required prior knowledge.
Language	English
Learning outcomes	Required elective modules have the purpose of enabling students to expand and extend their knowledge of fundamental principles of their field and/or specialise in an area of information engineering's application, such as alternative/renewable energy sources, climate-friendly applications, autonomous driving systems, smart home technologies, machine learning and wireless communication. Engineering-related skills At the conclusion of this module, students are able to - use the knowledge of STEM subjects (such as physics and electronics) acquired in the course of their degrees to date in tackling applied problems and tasks in electrical engineering - distinguish key subfield-specific terms, approaches and points of view from one another and understand their significance - comprehend the underlying electrical engineering problems associated with solutions in a specific field of application - take into account specific requirements for electrical engineering solutions in a particular field of application - correctly contextualise specific requirements of and approaches to solutions in the field (e.g. in relation to areas of work such as R&D, technical aftercare, management accounting, product approval and quality management) Methodological skills At the conclusion of this module, students are able to - apply methods and approaches from the general field of engineering (such as elements of good scientific practice) to problems from a specific field of application - assess the benefits and drawbacks of specific approaches to solving a problem from the relevant subfield and apply this assessment in (for example) practice tasks - follow specialist discourse (e.g. at conferences, in scientific periodicals or fora), engaging actively in the discourse where appropriate Interpersonal skills (communication and cooperation)

	At the conclusion of this module, students are able to - understand and reflect on the interdisciplinary character of electrical engineering, particularly in its interactions with related disciplines such as mechanical engineering and computer science - present solutions they have designed themselves to others and respond constructively to criticism and suggestions for improvement Professional competencies (scientific identity, professional actions) At the conclusion of this module, students: - have a more realistic idea of engineering as a field of work and greater clarity on potential directions for their future careers
Learning content	The specific content of the module is dependent on the student's individual choice. Students can access descriptions of currently available required elective modules on their degree course's website prior to the commencement of each semester
Usability of the module	The elective module serves to deepen the basics and/or specialization in an application area of information technology. The knowledge acquired so far should be used as widely as possible and elaborated in relation to the area of specialization. The module prepares for the complexity of tasks in the practical semester and in the bachelor thesis. In addition, the students come into contact with possible professional fields. (Scientific and technical courses can also be used other courses at HAW Hamburg or at other universities be chosen, provided that these are compatible with the objectives of the course to match. The latter requires the prior consent of the subject advisor and approval by the examination board.)
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Lecture: Successful passing in written examination (K), oral exam (M), paper (R) (PL) The examination type to be used is to be made known by the responsible lecturer at the start of the course. Laboratory: Successful participation in exercises (LA) or paper (R) (PVL)
Courses	CM1 (Lecture) CML1 (Laboratory / Exercises)
Type of Media	CM1: Tuition in seminars, blackboard, slides, computer simulation CML1: Laboratory- and computerpractical course
Literature	see the respective elective module description

Bachelor Information Engineering	
Compulsory Elective Project 2	
Abbreviation	CJ2
Module responsibility	Studiengangsleiter*in
Duration / Semester/ Regular cycle	one semester / 7. semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	5 CP 3 + 1 SHW
Workload	Attendance: 68 h Self-study: 82 h
Type of module	Compulsory elective module 2
Prerequisites	-
Language	English
Learning outcomes	Professional competencies (scientific identity, professional actions) At the conclusion of this module, students: · have reinforced their skill set by completing a project and accessed new challenges · have improved their practical skills in analysing and solving a problem and making decisions within a specified timeframe · have attained new knowledge and methodological skills through academic dialogue with experts in their field, the study of specialist literature and the practical application of insights from scientific research · have achieved stronger communicative competencies by discussing interim results and presenting final findings of their project work to others · are able to document their findings in a manner typical of a qualified engineer and appropriate for the field of engineering. -
Learning content	The project is intended to help students consolidate and expand the knowledge and skills acquired in their degree course to date and prepare them for work on their Bachelor thesis. Students choose a topic from the field of information/communication or energy engineering and make contact with appropriate organisations or individuals as required for the purpose of conducting the project. Students are expected to incorporate insights and methods from scientific research into their project and include references to appropriate specialist literature. Students produce a written report on their project in line with the principles and standards of good scientific/academic practice, including an outline of the problem they chose to analyse, the stages of work its solution entailed, the methods used and the project’s findings/results

Usability of the module	Degree program Information Engineering Degree program Elektro- und Informationstechnik Degree program Regenerative Energiesysteme und Energiemanagement
Requirements for the recognition of credits (Study and exam requirements)	Project work (presentations of project planning and results, final project report) (Pj) (PL)
Courses	CJ2 (project)
Type of Media	CJ2: blackboard, computer simulation, practical work at PC and in electronics lab
Literature	In the current issue: • Juana Clark Craig - Project Management Lite: Just Enough to Get the Job Done...Nothing More

Bachelor Information Engineering	
Bachelor thesis with colloquium	
Abbreviation	BA
Module responsibility	Prüfungsausschussvorsitzende(r)
Duration / Semester/ Regular cycle	one semester / 7th semester / winter and summer semester
Credits (CP) / Semester hours per week (SHW)	12 LP Bachelor thesis 3 LP Colloquium
Workload	self-study: 450
Type of module	Thesis
Prerequisites	The bachelor thesis can be registered if all but three module examinations have been successfully completed. The extent of the missing study, pre-examination and examination performances may not exceed 15 credit points.
Language	English or German
Learning outcomes	**Technical content and methodological skills:** The students - are able to work independently on a complex task from the scientific, application-oriented or professional fields of activity of the degree program using scientific methods and knowledge and to classify it in the interdisciplinary context, - can apply their theoretical and methodical knowledge independently, - have in-depth problem-solving skills, - know the boundary conditions, the state of the art and the legal regulations, norms and standards, the subject areas relevant for the solution of the task, - can present, evaluate and discuss the solution approaches - in writing and as a presentation. **Social and personal skills:** The students: - can work on tasks with an interdisciplinary character and can recognize and define interfaces, - can evaluate and evaluate engineering solutions and consider the results economically, - can represent and present the results scientifically and present complex relationships in a short written form as comprehensively as possible and distinguish the essential from the irrelevant.
Learning content	The bachelor thesis is a theoretical, programming, empirical and/or experimental thesis with a written elaboration. In the bachelor thesis, the students should show that they are able to independently work on a problem from the scientific, application-oriented or professional fields of activity of this course using scientific methods and knowledge and to classify it in the interdisciplinary context.

	Processing usually takes place in the following phases: - Familiarization with the topic and the current state of the art/research. - Incorporation/selection of methods and techniques for problem solving. - Development of a solution concept. - Implementation/realization of your own concept/approach. - Validation and evaluation of the results. - Presentation of the results in written form. - Colloquium consisting of a presentation followed by a discussion. In the bachelor thesis, the student is working on an individual task according to the learning objectives in coordination between a professor and a company or a task as part of the project work at the university. The definition of the task is always carried out by a university lecturer.
Usability of the module	Degree program Bachelor Information Engineering
Requirements for the recognition of credits (Study and exam requirements)	Regular examination type for module testing: Written thesis (12 LP) Colloquium (with presentation and oral exam) (3 LP)
Courses	BT (Bachelor thesis with colloquium)
Type of Media	BT: independent scientific work
Literature	In the current issue: • H. Corsten, J. Deppe: Technik des wissenschaftlichen Arbeitens. München. • N. Franck, J. Stary: Die Technik wissenschaftlichen Arbeitens. Eine praktische Anleitung, Paderborn. • M. Kornmeier: Wissenschaftlich schreiben leicht gemacht: für Bachelor, Master und Dissertation, UTB (Haupt- Verlag) Bern. • Brink: Anfertigung wissenschaftlicher Arbeiten. München/Wien. • T. Plümper: Effizient Schreiben: Leitfaden zum Verfassen von Qualifizierungsarbeiten und wissenschaftlichen Texten, Oldenbourg Verlag.