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2025/26

COBURG UNIVERSITY of applied sciences and arts | DEPARTMENT OF Electrical Engineering and Computer Science

# Module Manual
# Draft Version

BACHELOR´S DEGREE COURSE
ELECTRICAL ENGINEERING FOR SUSTAINABLE AND RENEWABLE ENERGY (ESR)

# Preamble:

**SWS – semester hour**

SWS is the German abbreviation for "semester hour" and indicates the number of 45-minute periods that a course comprises per week during the lecture period of a semester.

One **ECTS-Point** according to the „European Credit and Accumulation Transfer System“ corresponds to a workload of 30 hours per semester.

Please **also note** the **program- und examination regulations** of the degree program.

**Qualification Goal:**

The Bachelor's degree program in Electrical Engineering for Sustainable and Renewable Energy leads to a first academic and professional qualification in the highly sought-after fields of energy engineering and renewable energies. Graduates have a broad basic knowledge and practical skills in the field of electrical engineering as well as in-depth knowledge of the fields and methods of energy technology and renewable energies. They are able to classify issues and subject areas professionally and analyze problems using the methods of the subject. As a profile-forming feature of the degree course, graduates have also acquired scientific, business and management-related knowledge. They can apply this knowledge and skills in a solution-oriented manner to the often interdisciplinary tasks of their profession and quickly familiarize themselves with one of the numerous fields of application. Graduates have acquired communicative, cooperative and intercultural skills in appropriate teaching and learning formats. They have a future-oriented professional self-image and a sense of responsibility. The integrated acquisition of a sound knowledge of German as well as Content and Language Integrated Learning in the main course of study makes it easier for non-German-speaking students to work academically in German and to start a career in German companies. Successful completion of the degree program qualifies students in particular to take on application-oriented specialist and initial management tasks, e.g. in the field of renewable energy generation, distribution, conversion and storage.

The degree also qualifies students to take up a Master's degree course.

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Language Learning

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# 1. First Study Phase – Semester 1

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|---|---|
| Name of Module | **Academic English Skills** |
| Abbreviation | |
| Form of Teaching / SWS | Online / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising:<br>▪ 60 hours online lecture<br>▪ 90 hours self-study |
| Semester | 1 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | ▪ Cultural awareness: recognition of cultural influences in the professional and academic environments.<br><br>▪ Academic and professional writing: techniques for correspondence, research reports and papers, as well as learning citation and referencing systems (e.g., APA, MLA).<br><br>▪ Academic reading: strategies for understanding and analysing scientific texts, critical reading and extracting relevant information from specialist literature. |

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| | ▪ Critical thinking: methods for analyzing, evaluating and synthesizing information in order to develop one's own scientific arguments.<br><br>▪ Vocabulary and terminology: development of a subject-specific vocabulary and academic idioms.<br>▪ Grammar and style: development of grammatical structures and stylistic devices that are common in an academic context.<br><br>▪ Oral communication: techniques for holding academic presentations and participating in academic discussions.<br><br>▪ Listening comprehension: strategies for understanding lectures, seminars and academic discussions. |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **German Basic 1 (Level A1)** |
| Abbreviation | |
| Form of Teaching / SWS | Online / 6 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 180 hours, comprising<br>• 67,5 contact hours<br>• 112,5 hours self-study |
| Term | 1st term, 1st theoretical study phase |
| Recurrence | Once a year in winter term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | Deutsch und Englisch |
| Use in other Programs | ▪ BA Automation and Robotics<br>▪ BA Digital Business Models and Technologies<br>▪ BA Engineering Physics<br>▪ BA Mechanical Engineering |
| Formal Requirements | Students are only permitted to enter the second semester (second stage of study) if they have completed the<br>German Basics 1 (Level A1) modules in accordance with the appendix to the study and examination requirements. |
| Other Requirements | n/a |
| Qualification Goals / Competences | **Language Proficiency A1 (Basic User, CEFR)**<br><br>**Spoken interaction**<br>○ Can describe simple aspects of daily life in a sequence of simple sentences, using simple words and elementary phrases where preparation is possible.<br>○ Can describe him/herself (name, age, family) using simple words and formulaic expressions where preparation is possible.<br>○ Can name an object (shape/colour) using elementary words and formulaic expressions where preparation is possible.<br>**Reading Comprehension** |

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| | ○ Can understand short texts on topics of personal interest (e.g. course announcements or stories on sport, music, travel) written in simple words and supported by illustrations and pictures.<br>○ Can find and understand simple and important information in advertisements for special events, on handouts and in brochures (e.g. what is on offer, costs and prices, dates and places of events, departure times, etc.).<br>○ Can understand short and simple messages (e.g. posts on social media or emails) suggesting when and where to meet.<br>**Written production**<br>○ Can give information on matters of personal relevance (e.g. likes and dislikes, family, pets) using simple words/signs and elementary expressions.<br>○ Can give basic personal information in writing (e.g. name, address, nationality), using the dictionary where appropriate.<br>○ Can use very simple words/signs and phrases to describe certain everyday objects (for example, the colour of a car, whether it is big or small). |
| Content | Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. Students can furthermore use language assistants, apps, online resources and similar tools to manage and expand their language learning. |
| Grading and Examination Achievements | Written exam (90 minutes) |
| Additional assignments | **Learning material:**<br>**Kurs DaF A1.** Deutsch für Studium und Beruf, Kurs- und Übungsbuch. 2023. KLETT: ISBN 978-3-12-676838-2<br>**Kurs DaF A1.** Deutsch für Studium und Beruf Kurs- und Übungsbuch, 2023. Hybride Ausgabe allango, KLETT: ISBN 978-3-12-676841-2. |
| Technical Tools | Notebook, Tablet, Headphones |
| Literature | 1. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>2. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25] |

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| | 3. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Wertenschlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4. |

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|---|---|
| Name of Module | **German Basic 2 (Level A2)** |
| Abbreviation | |
| Form of Teaching / SWS | 12 SWS |
| Credits | 7 ECTS |
| Workload | Overall workload: 360 hours, comprising<br>• 135 contact hours<br>• 225 hours self-study |
| Term | 1st term, 1st theoretical study phase |
| Recurrence | Once a year in winter term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German and Englisch |
| Use in other Programs | ▪ BA Automation and Robotics<br>▪ BA Digital Business Models and Technologies<br>▪ BA Engineering Physics<br>▪ BA Mechanical Engineering |
| Formal Requirements | Students are only permitted to enter the second semester (second stage of study) if they have completed the<br>German Basics 1 (Level A1) modules in accordance with the appendix to the study and examination requirements. |
| Other Requirements | n/a |
| Qualification Goals / Competences | **Language Proficiency A2 (Basic User, CEFR)**<br><br>**Spoken interaction**<br>○ Can give a short, straightforward presentation on a familiar topic in own field with sufficient clarity to be followed with most effort, explaining the main points with sufficient precision.<br>○ Can describe plans and arrangements, habits and daily activities and talk about past activities and personal experiences.<br>○ Can report on aspects of own daily life, e.g. people, places, experiences in work and education. |

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| | **Reading Comprehension**<br>○ Can understand very simple formal emails and letters (e.g. confirmations of bookings or online purchases) / Can understand short personal letters.<br>○ Can find concrete, predictable information in simple everyday texts, e.g. advertisements, leaflets, menus, biblio-graphies and timetables.<br>○ Can understand a short factual presentation or report on own field of interest provided it is written in simple language and does not contain unpredictable details.<br><br>**Written production**<br>○ Can write in connected sentences about everyday as-pects of own environment, such as people, places, a job or study experiences.<br>○ Can write a series of simple sentences about own fam-ily, personal circumstances, educational background, current or previous occupation.<br>○ Can write a very short, elementary description of events, past actions and personal experiences. |
| Content | Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German.  German is usually the second, third or addi-tional language English. It is of central importance for multilin-gual learners to recognise the language as a system (lan-guage comparison). In this way, they develop a deeper un-derstanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. Students can furthermore use language assistants, apps, online resources and similar tools to manage and expand their language learning. |
| Grading and Examination Achie-vements | Written exam (90 minutes) |
| Additional assignments | **Learning material:**<br>**Kurs DaF A2.** Deutsch für Studium und Beruf, Kurs- und Übungsbuch. 2024. KLETT: ISBN 978-3-12-676840-5.<br>**Kurs DaF A2.** Deutsch für Studium und Beruf Kurs- und Übungsbuch. 2024. Hybride Ausgabe allango, KLETT: ISBN 978-3-12-676840-5. |
| Technical Tools | Notebook, Tablet, Headphones |
| Literature | 4. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>5. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25]<br>6. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Werten- |

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| | schlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4. |

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| Name of Module | **Introduction to Advanced Mathematics** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours online lectures<br>▪ 105 hours self-study |
| Semester | 1 |
| Recurrence | Once a year in winter term |
| Duration | one semester |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | Numbering systems<br>▪ Calculating with rational numbers<br>▪ Percentages<br>▪ Real and complex numbers<br><br>Important real-value functions<br>▪ Potencies and roots<br>▪ Logarithms<br>▪ Sine and cosine, tangent<br><br>Basic equations<br>▪ The Linear and quadratic equation<br>▪ Fractional equations<br>▪ Root and exponential equations<br>▪ Triogonometric equations |

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| | Fundamentals of geometry<br>▪ Triangle theorems, similar triangles<br>▪ Area of plane shapes<br>▪ Surface area, body volume<br>▪ The Cartesian coordinate system |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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| Name of Module | **Scientific Basics** |
| Abbreviation | |
| Form of Teaching / SWS | Online / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours online lectures<br>▪ 105 hours self-study |
| Semester | 1 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | Physical quantities and their units<br>▪The International System of Units<br>▪Physical constants of nature<br>▪Dealing with very small / large values, prefixes<br><br>Basics of experimentation<br>▪ Planning and conducting experiments<br>▪ Observation and data collection<br>▪ Evaluation, conclusion and documentation<br><br>The Structure of atoms<br>▪ Structure of atomic nuclei und nuclear reactions<br>▪ Bohr's atomic model<br>▪ Atomistic interpretation of physical effects |

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| | Chemical and physical bonding<br>▪ Energetically stable atoms and the octet rule<br>▪ Ionic and metallic bond<br>▪ Covalent bond (electron pair bond)<br>▪ The van der Waals interaction, hydrogen bond<br><br>The states of matter<br>▪ Solids, liquids, gases and plasma state<br>▪ The change of the aggregte state, phase diagrams<br>▪ Mixtures of substances<br>▪ Some selected physical properties of matter<br><br>Chemical reactions and stoichiometry<br>▪ Reaction equation, law of conservation of mass<br>▪ Exothermic and endothermic reactions |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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| Name of Module | **Soft Skills and Culture** |
| Abbreviation | |
| Form of Teaching / SWS | Online / 2 SWS |
| Credits | 3 ECTS |
| Workload | Overall workload: 90 hours, comprising<br>▪ 20 hours online lecture<br>▪ 40 hours self-study<br>▪ 30 hours attended event (blocked in Coburg and surroundings) |
| Semester | 1 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | Historical context from Middle Ages to Germany today.<br>Political system and its main consequences.<br>Cultural awareness and cross-cultural communications.<br>Understanding the German/European mindset.<br>Working together and the German work culture.<br>Studying in Germany.<br>Some typical German customs.<br>Excursions to the Coburg area and its Neighbors. |

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| Grading and Examination Achieve-ments | |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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## 2. Second Study Phase – Semester 2 to 4

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| Name of Module | **AC Technology for Energy Engineering** |
| Abbreviation | |
| Form of Teaching / SWS | in-person lecture (3 SWS), in-person exercise (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 3 |
| Recurrence | Once a year in winter term |
| Duration | One term |
| Module Responsibility | Prof. Dr. Omid Forati Kashani |
| Lecturer | Prof. Dr. Omid Forati Kashani |
| Language of Instruction and examination | English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Prior knowledge about fundamentals of electrical circuit calculations and components such as Ohm's law and Kirchhoff's circuit laws also resistors, conductors and capacitors. Knowledge about vector algebra. |
| Qualification Goals / Competences | In this module students know fundamentals of AC systems and can apply solutions regarding calculation of some quantities such as current, voltage and power. They know single-phase and three-phase systems under balanced and unbalanced circumstances and can calculate fundamental electrical quantities of them.<br>Students understand how single-phase and three-phase transformers are built and know their functionality. They can also calculate fundamental quantities of transformers.<br>Students understand fundamentals of power transmission via powerlines and the types and functionality of circuit breakers and disconnect switches |
| Content | Fundamentals of Alternating Current |

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| | - Generating of AC voltage<br>- AC function and its properties<br>- AC quantities and functions as complex numbers and vectors<br>- Vector diagram of AC quantities<br>- Power in AC systems<br><br>Three-phase systems<br>- Generating of three-phase voltages<br>- Star- and Delta connection<br>- Current, voltage and power in balanced three-phase systems<br>- Current, voltage and power in unbalanced three-phase systems<br><br>Single-phase transformers<br>- Construction of single-phase transformer<br>- Induction and functionality of single-phase transformer<br>- Power losses<br>- Equivalent circuit of single-phase transformer<br><br>Three-phase transformers<br>- Construction of three-phase transformer<br>- Types of winding connections and voltage relations<br>- Single-phase equivalent circuit of three-phase transformer<br>- Phase shifting via three-phase transformer<br><br>AC transmission powerlines<br>- Construction of AC powerlines or cables<br>- Power losses and phase shifting via AC powerline or cable<br>- Single-phase equivalent circuit of an AC powerline or cable<br><br>AC circuit breakers and disconnect switches<br>- Types and functionality of low voltage circuit breaker<br>- Types and functionality of medium and high voltage circuit breaker<br>- Types and functionality of high voltage disconnect switches |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | Blackboard, overhead / beamer / document camera / whiteboard<br><br>Electronically provided work documents and exercises |
| Literature | - William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, Engineering Circuit Analysis, McGraw Hill, 10th Edition |

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| | - A Fitzgerald, Charles Kingsley, Stephen Umans, Electric Machinery, McGraw Hill, 6th Edition<br>- William H Hayt, Engineering Electromagnetics, McGraw Hill, 4th Edition |

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| Name of Module | **Control Systems** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours on-site and online lecture (alternating)<br>▪ 90 hours self-study |
| Semester | 4 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Kolja Kühnlenz |
| Lecturer | Prof. Dr. Kolja Kühnlenz |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | **Systems modeling and analysis**<br>*System modeling and representation*<br>• differential equations, transfer function, Nyquist-plot, Bode-diagram, state-space<br>• analysis of system characteristics<br>• linearization<br>• Closed-loop structure<br><br>**Control plants**<br>*Typical controllers and plants*<br>• P, I, D, $PT_n$,$PDT_1$<br>**Stability** |

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| | Analysis of systems stability<br>• BIBO and Lypubov-Stability<br>• Routh-Hurwitz criterion<br>• Lypunov's direct method<br>**Closed-loop control**<br>*Structures and performance criteria*<br>• typical controller-plant combinations<br>• performance parameters<br>• controller design in time- and frequency domain |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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| Name of Module | **Electrical Components and Devices** |
| Abbreviation | |
| Form of Teaching / SWS | 4 SWS |
| Credits | 5 ECTS |
| Workload | tbd |
| Semester | 4 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Alexander Stadler |
| Lecturer | Prof. Dr. Alexander Stadler |
| Language of Instruction and examination | English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | tbd |
| Content | tbd |
| Grading and Examination Achieve-ments | tbd |
| Additional assignments | |
| Technical Tools | tbd |
| Literature | tbd |

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|---|---|
| Name of Module | **Electrical Drives, Power Grids and Safety** |
| Abbreviation | EANz |
| Form of Teaching / SWS | in-person lecture (2 SWS), in-person exercise (1 SWS), in-person practicum (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 4 |
| Recurrence | Once a year in summer term |
| Duration | One term |
| Module Responsibility | Prof. Dr. Omid Forati Kashani |
| Lecturer | Prof. Dr. Omid Forati Kashani, Prof. Dr. Michael Rossner |
| Language of Instruction and examination | English |
| Use in other Programs | AU |
| Formal Requirements | |
| Other Requirements | Prior knowledge about complex calculation in the field of AC-Current and vector diagrams. Basic knowledge about magnetic fields and electronic components. Knowledge about mechanics and relations between mechanical quantities. |
| Qualification Goals / Competences | In this module students study fundamentals of DC Machines and topologies of static converters which can be used feeding DC Machines. They study also fundamentals of three-phase systems generating a rotational magnetic field in a three-phase machine. Based on that rotating magnetic field the students understand how induction and synchronous Machines work. They will be able to draw and apply various characteristic curves of three-phase Machines solving electromechanical problems in steady state cases regarding electrical and mechanical quantities.<br><br>In electrical grids part of the module students study the fundamentals of electrical energy transmission and power analysis in three-phase grids. They understand the advantages and disadvantages of different grid configurations and their safety aspects. They will be also familiar with calculation methods for short circuit currents, voltage drops and cable dimensioning. |

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| Content | DC Machines<br>- Structure and mode of operation, armature winding of a DC machine, air gap fields and operating behavior, voltage generation and torque, types of DC machines, characteristics and control of DC machines, no-load characteristic, speed-torque characteristic, methods for speed changing<br>- structure and mode of operation of power converters for drives with DC Machines: buck converters, boost converters, four-quadrant converters.<br>Introduction to three-phase systems<br>- Balanced three-phase system, unbalanced three-phase system, currents and voltages of balanced and unbalanced systems. Three-phase power, power factor.<br>Three-phase induction Machines<br>- Generation of rotating magnetic fields, displaced three-phase windings<br>- Structure and operation of induction Machines, voltage equations and equivalent circuit, power balance, speed- or slip-torque characteristic curve, speed control of induction Machines, operating range of the three-phase induction Machines, starting, special designs of the squirrel-cage rotor.<br>Three-phase synchronous Machines<br>- Structure and operation of synchronous Machines, equivalent circuit and vector diagram of cylindrical-rotor synchronous Machines, island mode and grid connected operation of the cylindrical-rotor synchronous Machines, V-curves of the cylindrical-rotor synchronous Machines, torque and stability of the cylindrical-rotor synchronous Machines, structure and special features of the salient pole Machines, torque and stability of the salient pole machines.<br>Power grids and safety<br>- Typs of energy transmission (direct current, alternating current, three-phase current), power and power measurement in three-phase power grids. Short-circuit calculations (balanced and simple cases of unbalanced circuits), power grid configuration typs (TN, TT, IT), fuse elements, protection regulations. Cable structures, installation methods, voltage drop calculations. |
| Grading and Examination Achievements | Written exam and practical study work |
| Additional assignments | |

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| Technical Tools | Blackboard, overhead / beamer / document camera / whiteboard<br>Electronically provided work documents and exercises, practical exercises on the test bench in the laboratory |
| Literature | - Rolf Fischer, Elektrische Maschinen, Karl Hanser Verlag München<br>- Helmut Späth, Elektrische Maschinen und Strom-richter, Verlag Braun Karlsruhe<br>- Johannes Teigelkötter, Energieeffiziente elektri-sche Antrie-be, Springer Verlag<br>- Joachim Specovius, Grundkurs Leistungselektro-nik, Springer Verlag<br>- Germar Müller und Bernd Ponik, Grundlagen elektrischer Maschinen, WILEY-VCH Verlag GmbH & Co. KGaA<br>- Gerhard Kiefer, VDE 0100 und die Praxis; VDE Verlag<br>- Ismail Kasikci, Projektierung von Niederspan-nungs- und Sicherheitsanlagen, Hüthig und Pflaum<br>- Klaus Heuck, Klaus-Dieter Dettmann; Elektrische Energie-versorgung; Vieweg-Verlag |
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| Name of Module | **Fluid Mechanics** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours lectures<br>▪ 105 hours self-study |
| Semester | 3 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Automation and Robotics<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | Students will be able to:<br>▪ Analyze hydrostatic systems:<br>o Calculate pressure<br>o Determine forces and moments<br><br>▪ Apply core fluid mechanics equations:<br>o One-dimensional continuity equation for pipe flows<br>o Steady and unsteady energy equation (Bernoulli equation)<br>o Momentum conservation theorem to calculate forces and moments in pipe systems<br><br>▪ Evaluate thermal systems: |

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| | o Calculate heat transfer by conduction in simple configurations<br><br>Students will understand:<br>▪ Fundamental fluid mechanics concepts:<br>o Basic principles and hydrostatics<br>o Fluid kinematics<br>o Incompressible flows and streamline theory<br>▪ Governing equations:<br>o Continuity equation<br>o Energy equation (Bernoulli)<br>o Momentum conservation theorem<br><br>▪ Flow behavior:<br>o Fundamentals of viscous flows<br>o Characteristics of laminar and turbulent flows<br>o Pipe flow dynamics<br><br>▪ Heat transfer:<br>o Basic conduction processes |
| Content | See Qualification Goals |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **Fundamentals in Computer-based Measurement Technology** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours lectures/lab<br>▪ 90 hours self-study |
| Semester | 3 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | Electrical Engineering for Sustainable and Renewable Energy<br>Engineering Physics<br>Mechenical Engineering |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | Measurement technology is a fundamental prerequisite for conducting physical experiments, as well as for technological development and progress. Today, it is standard practice to collect measurement data digitally and via computer in order to process it further.<br>In this module, you will get to know common sensors and learn how to condition their signals using appropriate measurement circuits so that they can be captured with the help of an analog-to-digital converter. You will also learn how to transfer the data to a PC and evaluate it there. In the lab, you will build the measurement circuits on your own breadboard, read various sensor signals using a microcontroller, and develop corresponding measurement programs on the PC. |

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| Content | **Lecture:**<br>• **Introduction**<br>Fundamentals of measurement technology, mechanical, electronic, and computer-based measurement, measurement chain<br>• **Sensors**<br>Detection of mechanical, thermodynamic, electromagnetic, and optical quantities<br>• **Signal Conditioning**<br>Conversion of measurement signals into voltage, amplification, adjustment of the measurement range<br>• **Data Acquisition**<br>Number systems in computing, sample & hold, DAC, ADC, measuring instruments, sampling theorem, windowing<br>• **Interfaces & Protocols**<br>Communication model, network topologies, RS-232, USB, GPIB, VISA, SCPI<br>• **Data Processing**<br>Digital filters, DFT<br>**Lab:**<br>The lab is based on individual experiment kits per student consisting of a prototype breadboard and a Raspberry Pi Pico microcontroller. The following topics are covered:<br>• **Project Introduction**<br>First MicroPython script, measurement with a photodiode<br>• **Measurement of Small Voltages**<br>Operational amplifiers, assembly of inverting and differential amplifiers, measurement of a thermocouple<br>• **Measurement of Currents**<br>Shunt resistor, transimpedance amplifier, measurement of a photodiode<br>• **Measurement of Resistances**<br>Building a Wheatstone bridge with an instrumentation amplifier, RTD, measurement of a strain gauge<br>• **Building a Multimeter**<br>Connecting an external 16-bit ADC, analog frontend for measuring voltage and current, |

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| | MicroPython script with command interpreter for communication with a PC, Python GUI |
| Grading and Examination Achievements | written exam |
| Additional assignments | |
| Technical Tools | |
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| Name of Module | **Fundamentals of Electrical Engineering** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours lectures<br>▪ 105 hours self-study |
| Semester | 2 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Bernd Hüttl |
| Lecturer | Prof. Dr. Bernd Hüttl |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Automation and Robotics<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | **Direct current technology**<br>▪ Simple electrical direct current circuits: Ohm's law, mesh-, node-, voltage- and current divider rules,<br>▪ Model of ideal and real linear voltage and current sources,<br>▪ Methods for calculating linear direct current networks: branch current-, mesh current- and node potential methods.<br><br>**Alternating current technology**<br>▪ Stationary sinusoidal alternating current in real representation,<br>▪ Linear two-pole alternating current technology: capacitors and coils,<br>▪ Simple circuits (series and parallel circuits) and oscillating circuits. |

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| | **Electric field**<br>▪ Introduction to the topics of electric charge, field strength, voltage, potential and capacitance,<br>▪ Calculation of electrostatic fields and potential fields for simple geometries,<br>▪ Matter in the electric field and polarization; energy and forces of the electric field,<br>▪ Fields of layered arrangements,<br>▪ Electric flow field.<br><br>**Magnetic field**<br>▪ Introduction to the static magnetic field in a vacuum: magnetic phenomena, Lorentz force and magnetic flux density, flow law and magnetic field strength,<br>▪ Magnetic field in matter: para-, dia- and ferromagnetism, permeability, simple magnetic circuits,<br>▪ Electromagnetic induction law: motion and rest induction, self-induction and mutual induction,<br>▪ Energy and forces of the magnetic field. |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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| Name of Module | **German Basics 3 (Level B1.1)** |
| Abbreviation | |
| Form of Teaching / SWS | 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 120 hours, comprising<br>• 45 contact hours<br>• 75 hours self-study |
| Term | 2nd term, 2nd theoretical study phase |
| Recurrence | Once a year in summer term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | Deutsch und Englisch |
| Use in other Programs | ▪ BA Automation and Robotics<br>▪ BA Digital Business Models and Technologies<br>▪ BA Engineering Physics<br>▪ BA Mechanical Engineering |
| Formal Requirements | n/a |
| Other Requirements | n/a |
| Qualification Goals / Competences | ***Language Proficiency B1.1 (Independent User, CEFR)***<br><br>***Spoken interaction***<br>○ *Can give straightforward descriptions or reports on a range of familiar topics in own field of interest*<br>○ *Can give short reasons or explanations for views, plans or actions.*<br>○ *Can give a prepared, straightforward presentation on a familiar topic in own field in such a way that it can usually be followed with ease, explaining the main points with sufficient precision.*<br><br>***Reading Comprehension***<br>○ *Can understand short texts on topics of personal interest (e.g. course announcements or stories on sport, music, travel) written in simple words and supported by illustrations and pictures.* |

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| | ○ *Can understand short and simple messages (e.g. posts on social media or emails) suggesting when and where to meet.*<br>○ *Can read uncomplicated non-fiction texts on topics related to own interests and areas of expertise with pacifying understanding.*<br>***Written production***<br>○ *Can produce straightforward, coherent text on a range of familiar topics within his/her field of interest, linking individual shorter passages in a linear sequence.*<br>○ *Can write a very short, elementary description of events, past actions and personal experiences*<br>○ *Can summarise, report and comment with some confidence on a wide range of factual information in his/her field, both on familiar routine matters and on less routine matters.* |
| Content | Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. Students can furthermore use language assistants, apps, online resources and similar tools to manage and expand their language learning. |
| Grading and Examination Achievements | Written exam (90-120 minutes) |
| Additional assignments | **Learning material:**<br>**Kurs DaF B1.** Deutsch für Studium und Beruf, Kurs- und Übungsbuch. 2025. KLETT: ISBN 978-3-12-676842-9.<br>**Kurs DaF B1.** Deutsch für Studium und Beruf Kurs- und Übungsbuch. 2024. Hybride Ausgabe allango, KLETT.<br><br>Subject-specific learning materials will be provided in the course. |
| Technical Tools | Notebook, Tablet, Headphones |
| Literature | 7. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>8. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25]<br>9. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Wertenschlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4. |

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| Name of Module | **Lecture Series - Renewable Energy Engineering** |
| Abbreviation | ENRv |
| Form of Teaching / SWS | Presence seminar-based teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 2 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Michael Rossner |
| Lecturer | Prof. Dr. Bernd Hüttl; Prof. Dr. Bettina Friedel, Prof. Dr. Omid Forati, Prof. Dr. Alexander Stadler; Prof. Dr. Michael Rossner; Prof. Dr. Christian Weindl |
| Language of Instruction and examination | English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Lecture content of the foundation course, in particular the basics of electrical engineering, mathematics and physics |
| Qualification Goals / Competences | Participants learn about problems and approaches in the field of renewable energies through lectures and independent project work. They develop a general understanding of primary energy chains, energy conversion and the problems of storage and distribution. Using selected examples, which you will work on in groups, you will learn initial calculation algorithms. In addition, they will be sensitised to the ELSI (ethical, legal and social issues) and sustainability aspects to be considered in the development of new technologies and will be able to critically assess the latter on this basis. They can research a given key topic and communicate the results in a presentation to a specialist audience. |
| Content | In the lecture series, changing current topics and developments in the field of renewable energies are taught in the form of frontal teaching and subsequent discussions. Furthermore, ELSI and sustainability aspects are taught and discussed on the basis of historical, current and future de- |

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| | velopments. In this context, students are also given an initial insight into the main topics of the specialisation course. The focus is on aspects of energy generation, energy distribution, storage and sector coupling.<br>In addition, the students work on a miniature project in the form of a group project in which they deal more intensively with questions from this area, also in the form of independent calculations. |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | Blackboard/whiteboard, beamer/overhead projector, electronically provided work documents |
| Literature | Publications and media contributions on the respective topic |

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| Name of Module | **Mathematical Applications** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours lectures<br>▪ 105 hours self-study |
| Semester | 4 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | Numerical Methods for<br>▪ Integration<br>▪ Solving Differential Equations (PDE, ODE)<br>▪ Solving Large-Scale Linear Systems<br><br>Statistics and Data Analysis<br>▪ Data Visualization<br>▪ PCA<br>▪ SVD<br><br>Signal Processing<br>▪ Fourier Transforms (DFT, FFT)<br>▪ FIR and IIR Filters<br>▪ Spectral Analysis<br><br>Optimization and Machine Learning |

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| | ▪ Linear and Nonlinear Optimization<br>▪ Gradient-Based Methods<br>▪ Introduction to Machine Learning: Classification, Regression, Clustering<br><br>Modeling and Simulation<br>▪ Physical Modeling with Differential Equations<br>▪ Monte Carlo Methods<br>▪ Stochastic Simulations and Random Processes |
| Grading and Examination Achievements | practical coursework |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **Mathematics 1** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 67.5 contact hours<br>▪ 82.5 hours self-study |
| Semester | 2 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | ▪ Set Theory<br>▪ Fundamentals of Complex Numbers<br>▪ Limits, Sequences, and Series<br>▪ Differential and Integral Calculus of Univariate Real-Valued Functions<br>▪ Matrices and Determinants<br>▪ Vector Spaces<br>▪ Linear Systems of Equations<br>▪ Algebraic Equations (up to Third Order) |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |

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| Name of Module | **Mathematics 2** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 67.5 contact hours<br>▪ 82.5 hours self-study |
| Semester | 3 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | ▪ First-Order Ordinary Differential Equations<br>▪ Higher-Order Linear Ordinary Differential Equations<br>▪ Vector Calculus (Multiple Integrals, Total Differential)<br>▪ Partial Differential Equations<br>▪ Systems of Linear Differential Equations<br>▪ Fundamentals of Numerical Integration |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |

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|---|---|
| Name of Module | **Mathematics 3** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 67.5 contact hours<br>▪ 82.5 hours self-study |
| Semester | 4 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | English |
| Use in other Programs | Automation and Robotics, Engineering Physics<br>Mechanical Engineering |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | This course provides key mathematical tools for modeling and analyzing engineering systems, emphasizing transformations and advanced calculus. Topics include Laplace and Fourier methods for signal analysis, discrete and Z-transforms for digital systems, and advanced integration and differential equations for multi-dimensional and dynamic problems. These foundations support applications in control systems, physics, and computational engineering. |
| Content | • Laplace Transform<br>• Fourier Series & Transform<br>• Discrete Fourier Transform<br>• Z-Transform<br>• Advanced Topics in Mathematics<br>    o Line Integrals, Multiple Integrals, Surface Integrals<br>    o Integral Theorems<br>    o Partial Differential Equations<br>    o Systems of Linear Differential Equations |

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| Name of Module | **Measurement Technology** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours lectures<br>▪ 90 hours self-study |
| Semester | 2 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Bettina Friedel |
| Lecturer | Prof. Dr. Bettina Friedel |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | ▪ Basic concepts of measurements:<br>units and standards, traceability, calculation of uncer-tainty, types of measurement errors, error propaga-tion, documentation<br><br>▪ Measuring Instruments:<br>Principle of measurement, structure/characteristics of an-alogue and digital multimeters, princi-ple/operation of an-alogue and digital oscilloscopes<br><br>▪ Sensors: |

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| | physical principles, common types, fabrication technologies, applications<br><br>▪ Methods for measurement of static and dynamic electrical quantities:<br>Current/voltage measurement, transient measurements, measurement range extension and measuring bridges, measurement of resistance and power, time and frequency, and other quantities<br><br>▪ Periodic Measurement Quantities<br>Averaging measured values from time diagrams, transformation to the frequency domain, representation of periodic measurement quantities as spectra, deriving characteristic values thereof and analysis of relationships between time and the spectrum<br><br>▪ Digital Measurement Technology<br>Sampling and amplitude quantization, quantization uncertainty, analogue/digital converters<br><br>▪ Practical Experiments<br>Application of the theoretical content, such as basic measurement methods and characteristics of periodic measurement signals |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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| Name of Module | **Programming (Python)** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours lectures<br>▪ 105 hours self-study |
| Semester | 2 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Jochen Merhof |
| Lecturer | Prof. Dr. Jochen Merhof |
| Language of Instruction and examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | **Fundamentals of Programming with Python**<br>What is programming? Why Python?<br>Setting up the development environment<br><br>**Variables, Data Types, and Expressions**<br>Variable assignment and core data types (int, float, str, bool)<br>Type conversions and basic operations (arithmetic, comparison, logical)<br><br>**Control Structures**<br>Conditional statements: if, elif, else<br>Loops: for, while, with break and continue<br>Nested conditions and loops |

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| | **Basic Data Structures and Functions**<br>Lists and tuples: creation, access, modification<br>Dictionaries and sets: key-value pairs, set operations<br>Defining and calling functions<br>Parameters, return values, scope of variables<br><br>**Files and Exceptions**<br>Reading/writing files, file modes<br>Basic exception handling with try, except, finally<br><br>**Object-Oriented Programming**<br>Classes, objects, constructors<br>Inheritance, polymorphism, method overriding<br><br>**Modules and Libraries**<br>Using and creating modules, working with packages (e.g. pip) |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **Technical German 1 (Level B1.2)** |
| Abbreviation | |
| Form of Teaching / SWS | 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 120 hours, comprising<br>• 45 contact hours<br>• 75 hours self-study |
| Term | 3rd term, 2nd theoretical study phase |
| Recurrence | Once a year in winter term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and<br>examination | Deutsch |
| Use in other Programs | ▪ BA Automation and Robotics<br>▪ BA Digital Business Models and Technologies<br>▪ BA Engineering Physics<br>▪ BA Mechanical Engineering |
| Formal Requirements | n/a |
| Other Requirements | n/a |

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| Qualification Goals / Competences | **Language Proficiency B1.2 (Independent User, CEFR)**<br><br>**Spoken interaction**<br>○ Can talk about everyday topics or more specialised topics from my own subject domain in an understandable way and give an opinion.<br>○ Can give and explain short, simple technical information, tasks or problems.<br>○ Can present information and ideas in a comprehensible way and use simple arguments to support them.<br>**Reading Comprehension**<br>○ Can understand the content of detailed instructions and assignments (e.g. the task of selecting specific information from a specialised text).<br>○ Can take relevant information from short and specialised texts for lectures and seminars.<br>○ Can understand information for instruments and methods in my technical subject area when it is read repeatedly.<br>**Written production**<br>○ Can take notes from basic articles or contributions on common specialised topics of general interest.<br>○ Can write simple texts (e.g. descriptions of experiments) on everyday topics and on more specialised topics from my own subject domain.<br>○ Can summarise, report and comment with some confidence on a wide range of factual information in his/her field, both on familiar routine matters and on less routine matters. |
| Content | Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. |
| Grading and Examination Achievements | Written exam (90-120 minutes) |
| Additional assignments | **Learning material:**<br>**Kurs DaF B1.** Deutsch für Studium und Beruf, Kurs- und Übungsbuch. 2025. KLETT: ISBN 978-3-12-676842-9.<br>**Kurs DaF B1.** Deutsch für Studium und Beruf Kurs- und Übungsbuch. 2024. Hybride Ausgabe allango, KLETT.<br>Subject-specific learning materials will be provided in the course. |
| Technical Tools | Notebook, Tablet, Headphones |

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| Literature | 10. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>11. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25]<br>12. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Wertenschlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4. |

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| Name of Module | **Technical German 2 (Level B2.1)** |
| Abbreviation | |
| Form of Teaching / SWS | 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 120 hours, comprising<br>• 45 contact hours<br>• 75 hours self-study |
| Term | 4th term, 2nd theoretical study phase |
| Recurrence | Once a year in summer term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | Deutsch |
| Use in other Programs | BA Digital Business Models and Technologies |
| Formal Requirements | study) if they have completed the German Basics 3 (Level B1.1) modules in accordance with the appendix to the study and examination requirements. |
| Other Requirements | n/a |
| Qualification Goals / Competences | **Language Proficiency B2.1 (Independent User, CEFR)**<br><br>**Spoken interaction**<br>○ Can actively participate in conversations and discussions in conversational situations and clearly justify and defend his/her views with explanations, arguments or comments.<br>○ Can give relatively clear and detailed descriptions of many topics in own subject or field of interest.<br>○ Can handle more complex language situations when dealing with authorities or service providers. |

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| | **Reading Comprehension**<br>◦ Can understand relatively fully information, arguments or opinions in texts on topics related to own area of study or interest.<br>◦ Can understand detailed reports, analyses and commentaries discussing contexts, opinions and viewpoints.<br>◦ Can quickly find key details in long and complex general and specialised texts.<br><br>**Written production**<br>◦ Can give a clearly structured presentation in the subject area and field of interest, varying from the prepared text where necessary and responding to questions from the audience.<br>◦ Can take up arguments from different text references in a text and weigh them against each other.<br>◦ Can comprehensively present a topic he/she has researched in a report or essay, summarising the opinions contained and listing and evaluating detailed information or facts. |
| Content | Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. – This course is baed on the CLIL model. |
| Grading and Examination Achievements | Written exam (90-120 minutes) |
| Additional assignments | **Learning material:**<br>Subject-specific learning materials will be provided in the course. |
| Technical Tools | Notebook, Tablet, Headphones |
| Literature | 13. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>14. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25]<br>15. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Wertenschlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4.<br>16. Heine, L.. 2015. „Lernziele“. In: Zeitschrift für Interkulturellen Fremdsprachenunterricht 20: 2, 15-20. Online abrufbar unter http://tujournals.ulb.tu-darmstadt.de/index.php/zif/ [10.04.25].<br>17. Lindemann, B. 2015. In: Zeitschrift für Interkulturellen Fremdspra- |

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| | chenunterricht 20: 2, 1-4. Online abrufbar unter http://tujournals.ulb.tu-darmstadt.de/index.php/zif/ [10.04.25]. |

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| Name of Module | **Thermodynamics** |
| Abbreviation | |
| Form of Teaching / SWS | presence teaching / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 45 hours lectures<br>▪ 105 hours self-study |
| Semester | 4 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and<br>examination | English |
| Use in other Programs | BA Mechanical Engineering<br>BA Electrical Engineering for Sustainable and Renewable Energy<br>BA Engineering Physics |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | Students will be able to:<br><br>▪ Distinguish between:<br>o State variables<br>o Process variables<br><br>▪ Calculate:<br>o Specific gas constants<br>o State variables in the two-phase region<br>o Properties of ideal gases and gas mixtures<br>o Cyclic thermodynamic processes<br><br>▪ Understand and apply:<br>o Phase diagrams<br>o The first law of thermodynamics to closed and open systems<br>o The second law of thermodynamics to various systems<br>Students will understand: |

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| | ▪ Concepts of:<br>o System and state<br>o Processes and process variables<br><br>▪ Thermodynamic principles:<br>o First law of thermodynamics<br>o Second law of thermodynamics<br><br>▪ Behavior of:<br>o Ideal gases and their state variables<br>o Gas mixtures, moist air, and steam<br><br>▪ Analysis of:<br>o Phase diagrams<br>o Cyclic processes in power-generating and work-absorbing machi-nes<br>o Selected adabatic flow processes |
| Content | See Qualification Goals |
| Grading and Examination Achievements | Written exam |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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## 3. Third Study Phase – Semester 5 and 6

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| Name of Module | **Chemie für Energieanwendungen (Chemistry for Energy Applications)** |
| Abbreviation | CEA |
| Form of Teaching / SWS | 4 SWS, seminar with integrated tutorial (3 SWS), laboratory course (1 SWS) |
| Credits | 5 ECTS |
| Workload | Contact hours: 60 h, self-study: 90 h |
| Semester | 5 |
| Recurrence | annually |
| Duration | 1 semester |
| Module Responsibility | Prof. Dr. Bettina Friedel |
| Lecturer | Prof. Dr. Bettina Friedel |
| Language of Instruction and examination | German/English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Basic knowledge of the structure of matter and electrostatics |
| Qualification Goals / Competences | Upon successful completion of this module, students will be able to:<br>• Apply fundamental and advanced concepts of physical, inorganic, and materials chemistry to current and emerging energy technologies.<br>• Critically evaluate the chemical principles underpinning renewable energy sources and energy storage systems.<br>• Design and interpret laboratory experiments related to energy materials, electrochemistry, and catalysis.<br>• Reflect on the societal and environmental impact of various energy technologies from a chemistry-centered perspective. |
| Content | This module explores the chemical foundations and technological applications of energy systems with a focus on sustainable and renewable solutions. Topics include:<br>• Introduction to Energy and Chemistry: Forms of energy, energy units, thermodynamics of energy transformations. |

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| | • Fossil Fuels and Environmental Impact: Chemical composition, combustion reactions, emissions, and mitigation strategies.<br>• Electrochemistry and Batteries: Principles of redox chemistry, electrochemical cells, lithium-ion and next-generation batteries.<br>• Fuel Cells and Hydrogen: Types of fuel cells, hydrogen production and storage, catalytic processes.<br>• Solar Energy Conversion: Photochemistry, photovoltaic materials, dye-sensitized and perovskite solar cells.<br>• Thermochemical and Photocatalytic Processes: Water splitting, $CO_2$ reduction, and artificial photosynthesis.<br>• Materials for Energy Applications: Solid-state chemistry of energy materials, nanostructures, and hybrid systems.<br>• Sustainability and Lifecycle Analysis: Chemical perspective on energy sustainability, resource availability, and environmental impact.<br>Laboratory sessions and tutorials are integral to the module, providing hands-on experience and reinforcing theoretical knowledge. |
| Grading and Examination Achievements | Written exam and practical performance record |
| Additional assignments | Lab reports |
| Technical Tools | Beamer, black board, Moodle-platform, electronically provided lecture hand-outs |
| Literature | • Housecroft, C. E., & Constable, E. C., Chemistry: An Introduction to Organic, Inorganic and Physical Chemistry (5th Edition), Pearson, 2016.<br>• Hoffmann, M. R., & Wagner, R. W., Environmental Chemistry, Wiley, 2022.<br>• Atkins, P., & de Paula, J., Elements of Physical Chemistry (7th Edition), Oxford University Press, 2016.<br>• Tucker, W. B. (2024). Chemistry: Energy, Matter, and Change. CRC Press. ISBN: 978-1-04-003700-3.<br>• Wittstock, G. (2023). Lehrbuch der Elektrochemie: Grundlagen, Methoden, Materialien, Anwendungen. Wiley-VCH. ISBN: 978-3-527-32784-3.<br>• Burrows, A., Holman, J., Lancaster, S., Overton, T., Parsons, A., Pilling, G., & Price, G. (2021). Chemistry³: Introducing Inorganic, Organic and Physical Chemistry (4th ed.). Oxford University Press. ISBN: 978-0-19-882998-0.<br>• Eliaz, N., & Gileadi, E. (2019). Physical Electrochemistry: Fundamentals, Techniques, and Applications (2nd ed.). Wiley-VCH. ISBN: 978-3-527-34139-9. |

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| Name of Module | **Elektrische Antriebs- und Stromrichtertechnik (Electrical Drives and Static Converters)** |
| Abbreviation | EAS |
| Form of Teaching / SWS | in-person lecture (2 SWS), in-person exercise (1 SWS), in-person practicum (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 6 |
| Recurrence | Once a year in summer term |
| Duration | One term |
| Module Responsibility | Prof. Dr. Omid Forati Kashani |
| Lecturer | Prof. Dr. Omid Forati Kashani |
| Language of Instruction and examination | German |
| Use in other Programs | AU |
| Formal Requirements | |
| Other Requirements | Prior knowledge about construction, working and various characteristic curves of Direct Current, Induction and Synchronous machines from the course “Electrical Drives, Power Grids and Safety” |
| Qualification Goals / Competences | In this module students can apply solutions in electrical drive technology and explain the functioning of power converter topologies such as rectifiers, inverters, and DC/DC converters for DC and three-phase systems. They are able to analyze and solve problems related to electrical drives in theory and practice and predict the behavior of electrical drives using the aforementioned components.<br>Students understand the fundamentals of electrical drives control and the associated boundary conditions and are able to apply the principled and fundamental methods. |
| Content | Fundamentals of Mechanics<br>- Translational and rotational motion, gearbox, steady state operation of a drive, stability condition of an operating point.<br>Drives with DC Machines |

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| | - Review of the types of DC Machines, operating behavior of DC Machines, dynamic operation of DC Machines.<br>Drives with three-phase Machines<br>- Review of the induction and synchronous Machines, operating behavior and control of the induction and synchronous Machines.<br>Special Machines<br>- Operation of the servo Motor, the stepper Motor, the switched reluctance Machine, the brushless DC Machine and the linear Motor.<br>Line-commutated converters<br>- Two-pulse bridge circuit, sixs-pulse bridge circuit and 12-pulse converters.<br>Self-commutated power converters<br>- Function and control of DC-DC converters, function and control of voltage source converters on the grid and machine side, pulse width modulation, function and control of current source converters.<br>Fundamentals of the electrical drives control<br>- Speed and torque control of DC drives, two-axis theory of three-phase machines and space vectors, control of three-phase Machines in the rotating coordinate system, control of the grid-side converters, space vector modulation. |
| Grading and Examination Achievements | Written exam and practical study work |
| Additional assignments | |
| Technical Tools | Blackboard, overhead / beamer / document camera / whiteboard<br>Electronically provided work documents and exercises, practical exercises on the test bench in the laboratory |
| Literature | - Hans-Christoph Skudelny, Elektrische Antriebe, Verlag der Augustinus Buchhandlung, 1997<br>- Hans-Christoph Skudelny, Stromrichtertechnik, Verlag der Augustinus Buchhandlung, 1997<br>- Helmut Späth, Elektrische Maschinen und Stromrichter, Verlag Braun Karlsruhe, 1991<br>- Rolf Fischer, Elektrische Maschinen, Karl Hanser Verlag München, 2011<br>- Johannes Teigelkötter, Energieeffiziente elektrische Antriebe, Springer Verlag, 2013 |

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| Name of Module | **Elektrische Energiespeicher (Electrical Energy Storage Systems)** |
| Abbreviation | EEs |
| Form of Teaching / SWS | in-person lecture (2 SWS), in-person exercise (1 SWS), in-person practicum (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 6 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Christian Weindl |
| Lecturer | Prof. Dr. Christian Weindl, Prof. Dr. Michael Rossner |
| Language of Instruction and examination | German |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Basic knowledge in electrical engineering |
| Qualification Goals / Competences | Expertise<br>After the course, students will be able to<br>- understand the basics of electrical energy systems and grid- and market-based storage requirements<br>- categorise the possible applications and benefits of different storage systems<br>- carry out calculations on storage requirements in the electricity supply<br>- analyse and calculate the storage potential of different storage systems<br>- analyse, evaluate and compare the technical and economic design criteria of energy storage systems according to the requirements<br>- understand electrochemical processes in battery storage systems (Pb, NiCd, NiMh, NiZn, Li-Ion, LiPo, $LiFePO_4$, ZnO, LiO, NaS, redox flow)<br>- Understand the influencing variables of different cell chemistries in lithium-ion batteries<br>- Understand and carry out basic measurement procedures for charging and discharging behaviour |

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| | - Understand and apply procedures for determining the state of charge (SOC)<br>- Understand and apply procedures for assessing the state of health (SOH) of chemical energy storage devices<br>- Understand the physical processes and efficiencies involved in H2 utilisation (electrolyser fuel cell systems)<br>- Carry out economic feasibility studies and understand amortisation calculations<br><br>Methodological competence<br>After the course, students will be able to categorise the properties of different electrical energy storage systems, select energy storage systems that meet the requirements and dimension them. They will have developed an understanding of the functionality, operation and characteristics of different types of energy storage systems and will be able to assess their use from an economic and environmental point of view. |
| Content | Storage requirements and potentials for grid integration of renewable energies<br>Technical and regulatory framework conditions for the use of storage - Increasing flexibility and resilience - Grid services<br>Properties, characteristics and cell chemistry of different energy storage systems (Pb, NiCd, NiMh, NiZn, Li-Ion, LiPo, LiFePO4, ZnO, LiO, NaS, redox flow)<br>Derivation of an abstract storage model<br>Hydraulic storage systems<br>Electromechanical storage systems<br>Electrostatic storage<br>Electrochemical battery storage<br>Evaluation criteria for the use of energy storage<br>Comparison and application scenarios of different storage technologies<br>Operation, ageing and economic efficiency of electrical energy storage<br>Operating principles of electrolyser/fuel cell systems<br>Practical course:<br>- Measurement methods - determining the cell properties of battery storage systems<br>- Application and comparison of different charging methods<br>- Determining the SOH (state of health) and SOC (state of charge)<br>- Derivation of cell models<br>- Design of battery systems<br>- Thermal load and humidity management on a H2-PEM fuel cell<br>- U_I characteristic curves in H2 fuel cells<br>Design of a battery monitoring and management system |

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| Grading and Examination Achieve-ments | Written exam and practical performance record |
| Additional assignments | |
| Technical Tools | Blackboard, projector, whiteboard, Moodle platform<br>Electronically provided handouts and exercises |
| Literature | Michael Sterner, Ingo Stadler: „Energiespeicher - Bedarf, Technologien, Integration“, Springer-Verlag, Erste Auflage 2014<br>Eckard Fahlbusch (Hersausg.): „Batterien als Energie-speicher“, Beuth Verlag GmbH Berlin Wien Zürich, Erste Auflage 2015<br>Frank S. Barnes, Jonah G. Levine: “Large Energy Storage Systems Handbook“, CRC Press – Taylor and Francis Group 2011<br>Erich Rummich: „Energiespeicher - Grundlagen, Kompo-nenten, Systeme und Anwendungen“, expert-verlag, 2009<br>Robert Schlögl: „Chemical Energy Storage“ Verlag Walter de Gruyter, 2013<br>Chris Menictas, Maria Skyllas-Kazarcos, Tuti Mariana Lim: “Advances in Batteries for Medium- and Large-Scale Energy Storage”, Woodhead Publishing – Elsevier Ltd., Cambridge, 2015 |

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| Name of Module | **Elektrische Energieverteilung (Electrical Energy Distribution)** |
| Abbreviation | EEv |
| Form of Teaching / SWS | Presence seminar-based teaching (3 SWS), in-person practical training (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 6 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Michael Rossner |
| Lecturer | Prof. Dr. Michael Rossner |
| Language of Instruction and examination | German |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Lecture content of the foundation course, in particular the basics of electrical engineering, mathematics and physics |
| Qualification Goals / Competences | - Knowledge of the structure of energy generation and distribution in Germany and Central Europe, with particuar consideration of renewable energy sources and their potential.<br>- Knowledge of the boundary conditions and factors influencing pricing on the electricity market, with a focus on strategies for balancing the high volatility of renewable energy sources.<br>- Students will be able to independently assess the profitability of investments, in particular using the linear and annuity approach.<br>- The steam power plant cycle can be calculated thermodynamically and the components of the power plant are understood. In particular, steam power processes in conjunction with large-scale solar thermal power plants and latent heat storage systems are taken into account<br>- Basic dimensioning criteria for transformers, synchronous generators and switches can be applied inde- |

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| | pendently. For switches, the focus is on the requirements of the DC topic, as required for HVDC transmission lines.<br>- The basics of voltage and frequency stability in the extra-high voltage grid can be applied as an example. In particular, the requirements of the lack of flywheels in PV, the effects of strong feed-in fluctuations due to renewable energies and their reactive power requirements for voltage maintenance are taken into account.<br>- The line equations can be used to calculate voltage and current distributions on lines.<br>- The requirements of a combined AC-DC grid in the extra-high voltage range for the distribution of renewable energies are focussed on<br>- Symmetrical short-circuit currents near and far from the generator can be calculated.<br>- The calculation of unbalanced short-circuits using the balanced components can be applied to simple examples.<br>- The basic features of fuse settings (differential, admittance and distance protection) are understood. In partic ular, the requirements of bidirectional feed-in (PV (decentralized)) are discussed<br>- Simple examples of load flow calculation can be calculated. |
| Content | **Seminar-based teaching**:<br>- Structure of the energy supply in Germany and Central Europe, taking into account the expansion potential of renewable energies and the associated restructuring of the power grid (AC-DC)<br>- Pricing and electricity market with regard to highly volatile feed-in from renewable energies<br>- Cost accounting<br>- Steam power process, thermodynamics<br>- Components of energy distribution (transformer, generator, switch, protection ....)<br>- Voltage and frequency maintenance, HVDC<br>- Line-bound wave propagation<br>- Medium-voltage line operating diagram<br>- Dimensioning of overhead lines and cables<br>- Symmetrical short circuit |

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| | - Short circuit near the generator<br>- Unbalanced components<br>- Load flow calculation<br>- Protective devices<br><br>**Practical training:**<br>- Measurements on line models 220kV and 20kV line simulation<br>- Short-circuit test, fuse settings<br>- Synchronisation (2-sided infeed) |
| Grading and Examination Achievements | Written exam and practical work reports |
| Additional assignments | |
| Technical Tools | Blackboard, Beamer, Script |
| Literature | K. Heuk; K-D Dettmann, D. Schulz; Elektrische Energieversorgung; Springer-Verlag; 9. Aufl. 2013<br>D. Oeding, B.R. Oswald; Elektrische Kraftwerke und Netze; Springer Verlag, 7. Aufl. 2004<br>D. Nells; Ch. Tuttas; Elektrische Energietechnik; B.G. Teubner Stuttgart, 1998<br>Hosemann; Boeck; Grundlagen der elektrischen Energietechnik; Springer-Verlag; 4. Aufl. 1990<br>Wolfgang Schluft, Taschenbuch der „Elektrischen Energietechnik“ Hanser Verlag 2007<br>U.Ungrad; W.Winkler; A.Wiszniewski; Schutztechnik in Elektroenergiesystemen; Springer-Verlag, 2.Aufl. 1994 |

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| Name of Module | **Hochspannungstechnik (High-Voltage Technology)** |
| Abbreviation | Hsp |
| Form of Teaching / SWS | Presence seminar-based teaching (3 SWS), practical training (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 5 |
| Recurrence | Once a year in winter term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Michael Rossner |
| Lecturer | Prof. Dr. Michael Rossner |
| Language of Instruction and examination | German |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Lecture content of the foundation course, in particular the basics of electrical engineering, mathematics and physics |
| Qualification Goals / Competences | **Expertise**<br>After the course, students will be able to:<br>- Calculate breakdown voltages in homogeneous and slightly inhomogeneous arrangements in air. The focus here is on the green gas offensive (replacement of the climate-damaging SF6 by air at higher pressure).<br>- Knowledge of different forms of discharge in inhomogeneous arrangements<br>- Knowledge of breakdown mechanisms in liquids and insulating materials. The focus is on HD polymers, which are used in the new HVDC cables (Südlink; Südostlink...).<br>- Calculation on high-voltage transformers according to the common equivalent circuit diagrams, taking into account mixed voltages behind DC converters. (HVDC connection; offshore)<br>- Knowledge of circuits for generating high DC voltages. (HVDC converter stations) |

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| | - Calculation and/or estimation of systematic measurement errors in HV measurement technology<br>- Design, evaluation and performance of surge voltage tests.<br>- Carrying out and assessing PD measurements.<br>- PD diagnostics for DC voltage (HVDC)<br>- Measurements with the shear bridge<br>- Calculations of multiple reflections in lossless lines. (Integration of underground cables into the overhead line network to increase acceptance of the required power lines)<br>- Calculate simple electric fields yourself and understand the basics of numerical field calculation using small examples.<br><br>**Methodenkompetenz**<br>Nach der Veranstaltung können die Studierenden Hochspannungsprüf- und Messaufbauten nach den gängigen Mess- und Prüfverfahren selbständig dimensionieren und entsprechende Messungen eigenständig durchführen. Sie haben ein Verständnis über die verschiedenen Entladungsformen entwickelt und können Durchschlagsspannungen in einfachen Geometrien berechnen. |
| Content | Generation of high voltages; measurement of high voltages<br>Measurement and testing methods in high-voltage technology<br>Special requirements of HV-DC measurement and testing technology<br>Shear bridge (C - tan. Delta), partial discharge measurement technology (AC + DC), surge voltage testing and statistical evaluation methods, PDP measurement technology<br>Field calculation<br>Breakdown mechanisms (gases (also SF6 substitutes, air at high pressure), liquids, solids)<br>Requirements for HV - DC technology<br>Space-charge weighted field, especially for HD-PE, which is required in HV-DC cables. Electric flow field, equivalent circuit diagrams, materials<br>Modelling of DC arcs for DC switches<br>Propagation of transient overvoltages<br><br>**Practical work:**<br>- Generation and measurement of high AC voltages Peak value/peak value; capacitive overvoltages |

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| | - Surge voltages 1.2/50 and statistics<br>- DC voltage generation, doublers, forms of discharge in inhomogeneous arrangements<br>- PD measurement and shear bridge<br>- FEM field simulation |
| Grading and Examination Achievements | Written exam and practical performance records |
| Additional assignments | |
| Technical Tools | Blackboard, projector, whiteboard, Moodle platform<br>Electronically provided handouts and exercises |
| Literature | Andreas Küchler, „Hochspannungstechnik“, Springer Verlag 2009, dritte Auflage<br>M. Beyer, W. Boeck, K. Möller, W. Zaengl, “Hochspannungstechnik, Theorie und praktische Grundlagen der Anwendung”, Springer Berlin Heidelberg New York, 1986<br>G. Hilgarth, “Hochspannungstechnik” B.G. Teubner Stuttgart, 2. Auflage 1992<br>Adolf Schwab, Hochspannungsmesstechnik, Springer Verlag 2. ,überarbeitete Auflage 2011<br>Wolfgang Schluft, Taschenbuch der „Elektrischen Energietechnik“ Hanser Verlag 2007<br>D. Kind, K. Feser „Hochspannungsversuchstechnik“, Vieweg Verlag, 5. Auflage 1995<br>D. Kind, H. Kärner, „Hochspannungsisoliertechnik“, Vieweg Verlag 1982 |

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| Name of Module | **Intelligente Energiesysteme (Intelligent Energy Systems)** |
| Abbreviation | IEs |
| Form of Teaching / SWS | in-person lecture with exercise (2 SWS), in-person practicum (2 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 6 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Christian Weindl |
| Lecturer | Prof. Dr. Christian Weindl, Prof. Dr. Michael Rossner |
| Language of Instruction and examination | German |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Basic knowledge in electrical engineering |
| Qualification Goals / Competences | Specialist skills<br>After the course, students will be able to<br>- describe the basic structure and operation of conventional electrical energy systems<br>- explain the requirements resulting from the change in energy supply<br>- describe the central components and equipment of intelligent energy systems<br>- understand the networked operation of renewable power generators (smart generation)<br>- Describe intelligent energy distribution systems and how they work - Smart Distribution<br>- Describe the requirements and use of resource-saving utilisation of flexibility<br>- Present requirements and solutions for the integration of electromobility (e-mobility)<br>- Perform and evaluate simulations of grid and resource utilisation with conventional and renewable feed-in |

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| | - develop and analyse solutions for voltage stability in sub-grids and spur lines<br>- have knowledge of active and reactive power transmission in electrical grids and of compensating for fluctuating renewable feed-ins<br>- describe the operationally required grid services and their provision by intelligent grids - smart grids<br>- Knowledge of the different communication methods and technologies<br>- Classification of regulatory framework conditions and application to grid operation and grid design<br><br>Methodological skills<br>After the course, students will be able to understand smart energy systems and the functioning of central components and analyse their operation. They will have developed an understanding of the technical, economic and legal framework conditions and know solutions to ensure the communication tasks required in smart grids for the resource-saving use of flexibility and the integration of electromobility. They are able to carry out basic simulations of the transmission behaviour of electrical energy supply grids and evaluate the results. |
| Content | Basic structure and interconnected operation of conventional electrical energy supply grids<br>Consequences of technical and economic change in the energy supply and the energy transition<br>Electrical energy supply equipment and components of smart grids<br>Structure and functioning of smart energy systems<br>Creation and utilisation of flexibility to increase resilience in renewably powered grids<br>Integration of electromobility (e-mobility)<br>Grid and equipment utilisation<br>Voltage stability in the medium-voltage and low-voltage grid<br>Communication methods and technologies in the smart grid<br>Legal framework and market economy principles<br>Practical course:<br>- Calculation/simulation of conventional electrical energy systems<br>- Development of regenerative supply scenarios<br>- Analysing and comparing the operating environment and balancing processes within the grid structures<br>- Development and simulation of methods for balancing volatile active and reactive load flows |

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| | Investigation of alternative options for the provision of grid services |
| Grading and Examination Achievements | Written exam and practical performance records |
| Additional assignments | |
| Technical Tools | Blackboard, projector, whiteboard, Moodle platform<br>Electronically provided handouts and exercises |
| Literature | Bernd Michael Buchholz; Zbigniew Styczynski: „Smart Grids: Grundlagen und Technologien der elektrischen Netze der Zukunft“, VDE Verlag, 2014<br>Elias Kyriakides; Siddharth Suryanarayanan; Vijay Vittal: “Electric Power Engineering Research and Education”, Chapter “Evolution of Smart Distribution Systems“, Springer Verlag, 2014<br>James Momoh: “Smart Grid: Fundamentals of Design and Analysis”, Wiley-IEEE-Press, 2012<br>Janaka Ekanayake; Nick Jenkins; Kithsiri Liyanage; Jianzhong Wu; Akihiko Yokoyama: “Smart Grid: Technology and Applications”, John Wiley & Sons Publication, 1st Edition , 2012<br>Gerhard Herold, „Elektrische Energieversorgung I“, J. Schlembach Fachverlaf, 2. Auflage, 2005<br>Gerhard Herold, „Elektrische Energieversorgung II“, J. Schlambach Fachverlag, 2. Auflage, 2008 |

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| Name of Module | **Introduction in Scientific Writing (Level C1.1)** |
| Abbreviation | |
| Form of Teaching / SWS | 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 120 hours, comprising<br>• 45 contact hours<br>• 75 hours self-study |
| Term | 6th term, 3rd theoretical study phase |
| Recurrence | Once a year in summer term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | Deutsch |
| Use in other Programs | n/a |
| Formal Requirements | Technical German 3 (Level B2.2) |
| Other Requirements | n/a |
| Qualification Goals / Competences | **Language Proficiency C1.1**<br>**Spoken interaction**<br>○ Can discuss the results of their analysis of a technical text and in a<br>○ Can define technical terms and build argumentation structures appropriate to the target audience.<br>○ Can present a complex topic in an appropriate, clear and well-structured way, prioritising the most important points<br><br>**Reading Comprehension**<br>○ Can understand long and complex instructions or directions that go beyond own field of specialisation or interest when difficult sections are read several times<br>○ Can analyse the subject-specific nature of relevant genres and conventions of scientific writing in technical texts.<br>○ Can understand detailed scientific reports, analyses and commentaries in which contexts, opinions and points of view are discussed |

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| | **Written production**<br>○ Can write about complex technical issues through the textual combination of language and image in technical contexts.<br>○ Can refer to arguments from the research literature (various sources) in their own scientific text and weigh them up against each other<br>○ Can present his/her own point of view on a research topic, highlighting main ideas and use examples to give reasons for his/her arguments. |
| Content | ▪ Specialised academic writing conventions: Reflection on the content, structure and style of academic texts as well as formal aspects (citation, illustrations and layout).<br>▪ Writing and reading strategies: teaching effective strategies for academic writing and reading.<br>▪ Planning the thesis: support in planning the Bachelor's thesis, including objectives, choice of methods, self-control and time management.<br>▪ Reflection on writing processes: Guidance on reflecting on individual writing processes and strategies in groups.<br>▪ Practical exercises: Carrying out practical exercises to apply the writing techniques and strategies learnt. |
| Grading and Examination Achievements | Practical work |
| Additional assignments | **Learning material:**<br>Subject-specific learning materials will be provided in the course. |
| Technical Tools | Notebook, Tablet, Headphones |
| Literature | 18. Bräuer, Gerd. 2023. Literacy Management als Schlüsselkompetenz in einer digitalisierten Welt: Ein Arbeitsbuch für Schreibende, Lehrende und Studierende. Opladen, Berlin, Toronto: Barbara Budrich.<br>19. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>20. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25]<br>21. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Wertenschlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4.<br>22. Graßmann, Regina. 2021. Fachintegrierte Schreiblehre in den angewandten Wissenschaften. Das Modell Interdisciplinary Academic Literacies. In: trans-kom Band 14, Nummer [1] (2021) [10.04.25]. |

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|---|---|
| Name of Module | **Leistungselektronik (Power Electronics)** |
| Abbreviation | |
| Form of Teaching / SWS | Presence seminar-based teaching (3 SWS), practical training (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 5 |
| Recurrence | Once a year in winter term |
| Duration | One term |
| Module Responsibility | Prof. Dr. Alexander Stadler |
| Lecturer | Prof. Dr. Alexander Stadler |
| Language of Instruction and examination | German |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Lecture content of the foundation course, in particular the basics of electrical engineering, mathematics and physics |
| Qualification Goals / Competences | Professional skills:<br>After attending the course, students will know<br>• basic power electronic circuits for electrical energy conversion in the field of renewable energies and can understand and explain their fundamentals<br>• state-of-the-art power semiconductors, their functionality, most important properties and applications<br>• passive components in power electronic circuits including their characteristics and parasitic effects. Students will be able to dimension the components in a practical manner<br>• the basic circuit simulation in SPICE including the modeling of the essential elements<br>• basic thermal calculations and can carry out these specifically to improve the thermal management of power electronic assemblies<br>Methodological skills: |

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| | By attending this course, students will be able to apply the interdisciplinary mathematical and physical principles specifically to the analysis and optimization of power electronic circuits in the field of renewable energies. They will understand the structure of practical circuits and be able to determine the key functional parameters using both, theoretical calculations and SPICE simulations as well. Furthermore, students will be able to independently research the state of the art in individual sub-areas using relevant sources and will be able to communicate the key results to their classmates in a short presentation. |
| Content | • Introduction: Electrical energy conversion through power electronics (application areas, development goals, classification of circuits, currently available power semiconductors, application examples)<br>• Fundamentals and definitions (characteristics of current and voltage signals, vector diagrams, complex AC calculations, Fourier analysis, active, apparent and reactive power, power factor)<br>• Power semiconductors (diodes, thyristors, transistors: MOSFET, bipolar transistor and IGBT and their SPICE modeling)<br>• DC-DC converters, power factor correction (PFC) and resonant converters including their circuit simulation in SPICE<br>• Introduction to thermal calculations (mechanisms of heat transfer: heat conduction, natural and forced convection, thermal radiation)<br>• Passive components (resistors, inductors, transformers, capacitors, diodes and transmission lines) and their basic modeling in SPICE |
| Grading and Examination Achievements | Written exam and Written exam and practical performance records |
| Additional assignments | |
| Technical Tools | Blackboard, projector, whiteboard, Moodle platform, electronically provided handouts and exercises |
| Literature | P. Denzel, Grundlagen der Übertragung elektrischer Energie, Springer-Verlag, 1966, ISBN-10: 3642869009<br><br>K. Heuck, K.-D. Dettmann, D. Schulz, Elektrische Energieversorgung: Erzeugung, Übertragung und Verteilung elektrischer Energie für Studium und Praxis, Verlag Springer Vieweg, 9. aktualisierte und korrigierte Auflage, 2013, ISBN-10: 383481699X |

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| | R. Marenbach, D. Nelles, C. Tuttas, Elektrische Energietechnik: Grundlagen, Energieversorgung, Antriebe und Leistungselektronik, Verlag Springer Vieweg, 2013, ISBN-10: 3834817406<br><br>U. Probst, Leistungselektronik für Bachelors: Grundlagen und praktische Anwendungen, Carl Hanser Verlag GmbH & Co. KG, 2. aktualisierte und erweiterte Auflage, 2011, ISBN-10: 3446427341<br><br>M. H. Rashid, SPICE for Power Electronics and Electric Power, Crc Press Inc. by Taylor & Francis Group, 4th Edition, 2024, ISBN-10: 1032256613<br><br>A. J. Schwab, Elektroenergiesysteme: Erzeugung, Transport, Übertragung und Verteilung elektrischer Energie, Springer-Verlag, 1. Auflage, 2006, ISBN-10: 3540296646<br><br>J. Specovius, Grundkurs Leistungselektronik: Bauelemente, Schaltungen und Systeme, Verlag Springer Vieweg, 7. aktualisierte und überarbeitete Auflage, 2015, ISBN-10: 3658033088<br><br>A. Wintrich, U. Nicolai, W. Tursky, T. Reimann, Applikationshandbuch Leistungshalbleiter, SEMIKRON International GmbH, 2010, ISBN-10: 393884356X<br><br>F. Zach, Leistungselektronik: Ein Handbuch Band 1 / Band 2, Springer-Verlag, 4. vollständig überarbeitete und erweiterte Auflage, 2010, ISBN-10: 3211892133 |

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| Name of Module | **Photovoltaik (Photovoltaics)** |
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| Abbreviation | Pv |
| Form of Teaching / SWS | Presence seminar-based teaching incl. exercise (3 SWS), practical training (1 SWS) / 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 150 hours, comprising<br>▪ 60 hours in-person lecture<br>▪ 90 hours self-study |
| Semester | 6 |
| Recurrence | Once a year in summer term |
| Duration | one term |
| Module Responsibility | Prof. Dr. Bernd Hüttl |
| Lecturer | Prof. Dr. Bernd Hüttl |
| Language of Instruction and examination | German |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | Fundamentals of electrical engineering, electronic components, physics |
| Qualification Goals / Competences | **Professional competences:**<br>After the course, students will be able to use the knowledge and skills they have acquired to<br>- to qualitatively and quantitatively describe the mode of operation of photovoltaic systems,<br>- to design photovoltaic systems,<br>- to create yield forecasts for photovoltaic systems with knowledge of the energy meteorological conditions,<br>- to carry out laboratory measurements, including under standard conditions, on photovoltaic components to determine key technical parameters.<br><br>**Methodological skills:**<br>After the course, students will be able to apply essential photovoltaic measurement methods in a safe and practical manner. |

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| | **Social skills:**<br>Practical work in project groups develops the ability to solve tasks in a team. |
| Content | - **Energy meteorology of photovoltaics**<br>Learning about the spectral, direct and diffuse properties of solar radiation as well as the solar energy supply on inclined photovoltaic generators and learning about the influence of variable temperatures on generators<br><br>**- Semiconductor technology aspects of solar cells**<br>In-depth study of the pn semiconductor model and application to solar cells, handling specific parameters of solar cells and calculation of solar cell efficiency, interconnection of solar cells to form modules, learning about cell technologies (production, properties, applications)<br><br>- **Photovoltaic system technology**<br>Learning about the main components of grid-connected and stand-alone systems (generators, string technologies, inverters, grid connection systems, storage and energy management systems) and designing such components<br><br>- **Yield calculations**<br>Preparation of yield forecasts based on irradiation conditions and system technology, evaluation of economic efficiency |
| Grading and Examination Achievements | Written exam and practical performance records |
| Additional assignments | Exercises for 'MicroCredits' |
| Technical Tools | Blackboard, projector, visualiser, Moodle platform<br>Electronically provided handouts and exercises |
| Literature | V. Quaschning: Regenerative Energiesysteme, Hanser Verlag<br>H. Häberlin: Photovoltaik, VDE Verlag<br>V. Wesselak, T. Schabbach: Regenerative Energietechnik,<br>Springer Verlag<br>K. Mertens: Photovoltaik, Hanser Verlag |

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| Name of Module | **Technical German 3 (Level B2.2)** |
| Abbreviation | |
| Form of Teaching / SWS | 4 SWS |
| Credits | 5 ECTS |
| Workload | Overall workload: 120 hours, comprising<br>• 45 contact hours<br>• 75 hours self-study |
| Term | 5th term, 3rd theoretical study phase |
| Recurrence | Once a year in winter term |
| Duration | One term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | Deutsch |
| Use in other Programs | BA Digital Business Models and Technologies |
| Formal Requirements | Students are only permitted to enter the fith semester (third stage of study) if they have completed the<br>German Basics 3 (Level B1.1) modules in accordance with the appendix to the study and examination requirements. |
| Other Requirements | n/a |
| Qualification Goals / Competences | **Language Proficiency B2.2 (Independent User, CEFR)**<br><br>**Spoken interaction**<br>○ Can understand key information in presentations, lectures and brief discourses on well-known topics in his/her field of specialisation or interest.<br>○ Can give a short report on a selected specialised topic.<br>○ Can actively contribute to formal discussions by giving arguments for his/her own point of view and commenting on comments made by others. |

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| | **Reading Comprehension**<br>◦ Can understand and compare sources of information and arguments in scientific texts.<br>◦ Can understand a specific procedure on the basis of a diagram.<br>◦ Can quickly find key details in long and complex general and specialised texts.<br><br>**Written production**<br>◦ Can write address-oriented, clearly structured texts on a complex topic and summarise the most important points in them.<br>◦ Can can formulate descriptive titles (e.g. for a presentation)<br>◦ Can write a summary of articles and reports on specialised topics of general interest. |
| Content | Students acquire linguistic and cultural competences (reading, listening, writing and speaking skills) for everyday life and study in German. German is usually the second, third or additional language English. It is of central importance for multilingual learners to recognise the language as a system (language comparison). In this way, they develop a deeper understanding of linguistic structures (grammar, lexis) and the cultural context, which improves their ability to communicate independently in everyday life. – This course is based on the CLIL model. |
| Grading and Examination Achievements | Written exam (90-120 minutes) |
| Additional assignments | **Learning material:**<br>Subject-specific learning materials will be provided in the course. |
| Technical Tools | Notebook, Tablet, Headphones |
| Literature | 23. Council of Europe: Global scale - Table 1 (CEFR 3.3): Common Reference levels (coe.int) Council of Europe: Official translations of the CEFR Global Scale (coe.int) [03.04.25]<br>24. Gemeinsamer Europäischer Referenzrahmen für Sprachen: lernen, lehren, beurteilen. Begleitband. 2020. Stuttgart: Klett, ISBN 978-3-12-676999-0. [03.04.25]<br>25. Glaboniat, M.; Müller, M.;Rusch, P.; Schmitz, Helen; Wertenschlag, L.. 2013. Profile deutsch A1-C2. 1. Aufl.. Lernzielbestimmungen, Kannbeschreibungen, Kommunikative Mittel. Stuttgart: Klett, ISBN 978-3-12-606518-4.<br>26. Heine, L.. 2015. „Lernziele“. In: Zeitschrift für Interkulturellen Fremdsprachenunterricht 20: 2, 15-20. Online abrufbar unter http://tujournals.ulb.tu-darmstadt.de/index.php/zif/ [10.04.25].<br>27. Lindemann, B. 2015. In: Zeitschrift für Interkulturellen Fremdsprachenunterricht 20: 2, 1-4. Online abrufbar unter http://tujournals.ulb.tu-darmstadt.de/index.php/zif/ [10.04.25]. |

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## 4. Industrial Internship – Semester 7

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| Name of Module | **Industrial Internship** |
| Abbreviation | |
| Form of Teaching / SWS | |
| Credits | 25 ECTS |
| Workload | Overall workload: 20 weeks full time work in a company |
| Semester | 7 |
| Recurrence | each term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German or English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | Application of theoretical knowledge to questions and topics in professional practice; the professional focus should be chosen according to the personal area of specialisation; possible areas are e.g. develo-pment, design, project planning, production, production preparation and control, quality management, optimisation of technical processes. |
| Grading and Examination Achievements | Practical Report |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **Industrial Internship – Accompanying Seminar 1** |
| Abbreviation | |
| Form of Teaching / SWS | Seminar presence teaching / 3 SWS |
| Credits | 3 ECTS |
| Workload | Overall workload: 112.5 hours, comprising<br>▪ 37.5 hours classroom study<br>▪ 75 hours self-study |
| Semester | 7 |
| Recurrence | each winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German or English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | The seminar deals with introduction to scientific work, organization of literature research, and ability to process information.<br>Identification of topics and learning fields literature research, literature procurement, information preparation, presentations, practical report, Bachelor's thesis |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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| Name of Module | **Industrial Internship – Accompaying Seminar 2** |
| Abbreviation | |
| Form of Teaching / SWS | Seminar presence teaching / 2 SWS |
| Credits | 2 ECTS |
| Workload | Overall workload: 75 hours, comprising<br>▪ 22.5 hours classroom study<br>▪ 52.5 hours self-study |
| Semester | 7 |
| Recurrence | each winter term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German or English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | The seminar deals with project management: basic project management methods and their application, consistent planning and work on projects in a team, collaboration skills and working techniques, social skills.<br><br>From the idea to the clarified assignment, project influences, roles in project management, cooperation in projects, visions and goals, procedure and milestones, overview of all project tasks, planning and controlling of projects, risk management, structure and preparation, classic PM and agile project management. |
| Grading and Examination Achievements | |
| Additional assignments | |
| Technical Tools | |

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## 5. Final Thesis

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| Name of Module | **Bachelor Colloquium** |
| Abbreviation | |
| Form of Teaching / SWS | |
| Credits | 3 ECTS |
| Workload | Overall workload: 90 hours |
| Semester | 8 |
| Recurrence | each term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German or English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | In the Bachelor Colloquium, the motivation and the main results of the Bachelor thesis are summarized and presented. The presentation serves to defend your own work and answer questions from experts and the audience. This shows that you have understood the topic well and are able to explain and discuss it. You receive valuable feedback that can be used to improve your work or for future projects.<br><br>▪ Summary of engineering and scientific results<br>▪ Designing and structuring a presentation, using suitable media<br>▪ Rhetoric in a professional context<br>▪ Discussion of scientific methods and expert knowledge |
| Grading and Examination Achievements | Präsentation |
| Additional assignments | |

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| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **Bachelor Thesis** |
| Abbreviation | |
| Form of Teaching / SWS | |
| Credits | 12 ECTS |
| Workload | Overall workload: 360 hours (project work) |
| Semester | 8 |
| Recurrence | each term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German or English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | Professional and methodological objectives:<br>The student is able to independently work on or solve a complex task from their degree program on a scientific basis. |
| Content | As part of the Bachelor's thesis, students usually work on an engineering problem in a company. There are a wide range of topics to choose from in the areas of development, design, modeling and simulation, testing, production and logistics, etc. The project is accompanied and supervised by a member of staff and a professor at the university. |
| Grading and Examination Achievements | Bachelor Thesis |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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|---|---|
| Name of Module | **Engineering Project** |
| Abbreviation | |
| Form of Teaching / SWS | |
| Credits | 10 ECTS |
| Workload | Overall workload: 300 hours |
| Semester | 8 |
| Recurrence | each term |
| Duration | one term |
| Module Responsibility | N.N. |
| Lecturer | N.N. |
| Language of Instruction and examination | German or English |
| Use in other Programs | |
| Formal Requirements | |
| Other Requirements | |
| Qualification Goals / Competences | |
| Content | The practical engineering project serves as a supplement to the Bachelor's thesis. Specialist knowledge and scientific methods are deepened. Usually, a topic related or interlinked with the Bachelor's thesis is worked on in the relevant company.<br>▪ Project organization and structuring<br>▪ Literature research<br>▪ Methodical knowledge acquisition<br>▪ Scientific evaluation and documentation |
| Grading and Examination Achievements | Scientific Report |
| Additional assignments | |
| Technical Tools | |
| Literature | |

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