Hochschule München
University of Applied Sciences

Fakultät für Elektrotechnik und Informationstechnik
Department of Electrical Engineering and Information Technology

Bachelor of Renewable Energy - Electrical Engineering

27.04.2026

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Programme Learning Outcomes

General Programme Learning Outcomes

The bachelor's degree programme in Regenerative Energies - Electrical Engineering provides students with knowledge, skills and competencies through practice-oriented teaching, enabling them to work independently as engineers in the field of regenerative energies and also in classical fields of electrical engineering. Graduates will be able to accompany and actively shape the rapidly advancing technical development of power engineering, especially in the field of renewable energies. They are able to work together with specialists in power technology whose career path is based on a non-electrotechnical education. The following essential knowledge is conveyed:

- Strong knowledge of the basics of mathematics and physics
- All basics of electrical engineering and information technology
- Advanced knowledge in the chosen field of specialization
- Basic knowledge of relevant non-technical topics, in particular economics and law as well as project management.

Students also acquire special skills with a focus on electrical power engineering:

- They are able to select suitable tools and procedures for solving technical problems.
- They know how to solve technical problems or tasks in a targeted manner.
- They are able to use and operate technical devices.
- They are familiar with relevant software tools (e.g. simulation).

Through their studies, students acquire technical, methodological and social skills. The following expertise should be acquired during the programme:

- Students recognize complex correlations, even across disciplines.
- They can analyse technical problems in electrical power engineering.
- They can create suitable solution concepts for these problems.

The main methodological skills to be mentioned are:

- Students can independently select, obtain and evaluate the information necessary to solve a problem.
- The students also have an awareness of non-technical issues and can in particular recognize the effects of technology on the environment and society and make them tolerable, i.e. assess the consequences of technology.

The following social skills should be acquired:

- Students can communicate facts and work results appropriately and present them in an understandable manner.
- Students can work productively in project teams and, if necessary, also take on the management of project teams.

Supplementary Learning Outcomes of Dual Students

Beyond the learning objectives achieved at the university, dual students acquire practical technical, methodological, and organisational competences that are directly anchored in real operational processes. They deepen their understanding of industrial technologies, standards, development, and production processes by applying content known from the university in specific projects, employing systematic analysis and problem-solving strategies. Through active participation in technical teams, they develop strong communication and social skills, which are essential for the execution of interdisciplinary tasks. Continuous engagement with operational requirements strengthens the ability to take technical decisions while considering economic efficiency, safety, the environment, and social impacts. At the same time, the parallel management of studies and practice fosters high levels of self-organisation, responsibility, and professional proficiency, facilitating the transition into the fields of activity within the engineering profession.

Technische Informatik 1

Modul

Module Name	Technische Informatik 1
Module Level	Bachelor
Credit Points per Module	7
Module Coordinator	Dr. Christian Kißling

General Information about the Course

German Title	Technische Informatik 1
English Title	Computer Engineering 1
Code	EG252 – Compulsory Subject
Semester	2
Frequency of C. Offer	normally every semester
Credit Points per Course	7
Course Coordinator	Dr. Christian Kißling
Hours per Week	6
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (5 SU + 1 Pra)
Workload	70 SU + 14 Pra + 126 preparation/post-processing = 210 hours
Language	german
Degree Programs	EI/RE/EM
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Christian Kißling (Modulverantw.), Dr. Joachim Schramm, Dr. Klaus Ressel, Dr. Eric-Roger Brücklmeier, Dr. habil. Alfred Schöttl, LbA Walter Tasin M. Sc., Dr. Gerhard Schillhuber, Dr. Monika Mühlbauer, Dr. Marek Galek, Dr. Felix Miller, Dr. Ulrich Unterhinninghofen, Dr. Markus Plattner, Dr. Clemens Hage

Recommended Requirements

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Module Objectives and Planned Learning Outcomes

Students understand basic computer architectures and they are familiar with the use of microcomputers.
They know properties and handling of a special 8 bit microcomputer and they are able to program basic software routines.
Furthermore students are able to transfer and to solve simple tasks from the digital area with a microcomputer.
Students know basic definitions of information theory, properties of different codes, logical operators and they are familiar with way how to design and analyze digital circuits.
They know properties of combinatorial and sequential circuits.
They are able to make simple calculations with binary numbers, to convert numbers into different numbering systems and they can transform and simplify binary equations using logical theorems.
Furthermore, students can realize and analyze combinatorial circuits.

Contents

- Basic computer architectures (Von Neumann, Harvard)
- Special properties, handling and use of an 8 bit microcomputer (structure and internal components, handling, design tools. Use of I/O-ports: connection of components, internal mode of operation
- Programming: Basics of microcomputer programming, variables, data structures,control structures, implementation of simple problems. Processing of examples
- Basics of information theory (information content, entropy)

- Codes (Numerical and alphanumerical codes, codes of variable length, error detection)
- number representation (Integer, binary complement, floating point, transformation)
- Arithmetic with binary numbers (basic arithmetics, implementation)
- Boolean algebra (logical operators, logical theorems)
- Minimization of boolean equations (graphical and tabular)
- description, analysation and synthesis of combinatorial circuits (decoder, coder, multiplexer, demultiplexer, arithmetic circuits),
- Digital storage elements (flipflops, register).

Literature

Schmitt: Mikrocomputertechnik mit Controllern der Atmel AVR-RISC-Familie, Oldenbourg Verlag
Spanner: AVR-Mikrocontroller in C programmieren, Franzis Verlag
Bremer: Digitaltechnik interaktiv!, Springer-Lehrbuch
Lipp: Grundlagen der Digitaltechnik, Oldenbourg Verlag München Wien
Siemers, Sikora: Taschenbuch der Digitaltechnik, Fachbuchverlag Leipzig
Urbanski, Woitowitz: Digitaltechnik, Springer-Lehrbuch
Ward, Halstead: Computation Structures, MIT-Press
Plate: Digitaltechnnik, http://www.netzmafia.de/skripten/digitaltechnik/

Examination

Method and Duration of Examination: schriftliche Prüfung 90 min + FrwL (0% Bonus)

Energieumwandlung

Modul

Module Name	Energieumwandlung
Module Level	Bachelor
Credit Points per Module	7
Module Coordinator	Dr. Stephanie Uhrig

General Information about the Course

German Title	Energieumwandlung
English Title	Energy Conversion
Code	RE495 – Compulsory Subject
Semester	4
Frequency of C. Offer	normally every semester
Credit Points per Course	7
Course Coordinator	Dr. Stephanie Uhrig
Hours per Week	6
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (4,67 SU + 1,3 Pra)
Workload	65 SU + 19 Pra + 126 preparation/post-processing = 210 hours
Language	german
Degree Programs	RE
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Stephanie Uhrig (Modulverantw.), Dr. Simon Schramm, Dr. Georg Kerber

Recommended Requirements

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Module Objectives and Planned Learning Outcomes

The students are familiar with basic concepts of power economics and power technology as well as the development of the current energy demand in Germany. They know and understand the most important conventional and renewable technologies for electrical power generation, their areas of application and the latest developments.
They are able to work out solutions for practical problems in electrical energy supply under the aspects of sustainability and environmental relevance. In the realization of the technical power supply concept, the students use suitable procedures to calculate the efficiency chain, the energy balance and the cost structure.

Contents

- Basic concepts of the powerindustry and electrical power supply
- Steam power plants, gas turbine power plants, combined cycle power plants, CHP plants
- Power plant operation and power procurement
- Frequency control and operating behavior in the European interconnected grid
- Operating behavior of synchronous generators and converter plants
- hydropower plants
- wind power plants
- Photovoltaic and solar thermal plants
- ORC process
- Stirling engines and fuel cells
- Practical course: operating behavior of small gas turbines, measurements on PV modules

Literature

Zahoransky: Energietechnik, Springer-Vieweg Verlag, 2015

Strauß: Kraftwerkstechnik zur Nutzung fossiler, nuklearer und regenerativer Energiequellen, Springer Verlag, 2016
Fischer: Elektrische Maschinen, Hanser Verlag, 2013
Quaschning: Regenerative Energiesysteme, Hanser Verlag, 2015
Heier: Windkraftanlagen: Systemauslegung, Netzintegration und Regelung,
Vieweg Teubner Verlag, 2009
Hau: Windkraftanlagen, Springer Verlag, 2014

Examination

Method and Duration of Examination: schriftliche Modulprüfung, 90 min + FrwL (0 % Bonus)

Programmieren

Modul

Module Name	Programmieren
Module Level	Bachelor
Credit Points per Module	6
Module Coordinator	Dr. habil. Alfred Schöttl

General Information about the Course

German Title	Programmieren
English Title	Programming
Code	RE493 – Compulsory Subject
Semester	4
Frequency of C. Offer	normally every semester
Credit Points per Course	6
Course Coordinator	Dr. habil. Alfred Schöttl
Hours per Week	5
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 2 Pra)
Workload	42 SU + 28 Pra + 110 preparation/post-processing = 180 hours
Language	german
Degree Programs	RE
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. habil. Alfred Schöttl (Modulverantw.), N.N.

Recommended Requirements

Computer Engineering 1, Microcomputer

Module Objectives and Planned Learning Outcomes

The students know of the most important concepts of the programming language Python. They understand the notion of a variable, an instance, and a value. The are aware of the data structures dictionary, tuple, list, set and their typical operations. The students are able to apply these data structures and their operations to problems.
The students are able to identify and implement variables, their data structure, and the necessary operational sequence in simple problems. The students can structurize programs by application of functions and modules. They know of the most important concepts of object-oriented programming. They are able to structurize and recycle problem solutions by designing class hierarchies.
The students know of selected libraries in the areas basic programming (e. g. strings, files), advances techniques (e. g. threads, networks, XML files) and applications (e. g. matrices, graphics, GUI).

Contents

Introduction

- The interactive shell
- Compiling and running a programm

Basic data types and operations on them

- Variables and simple data types
- Operators, functions, methods and attributes
- sequential data types, directories and sets

Expressions
Flow control

- Alternatives and loops
- Comprehensions
- Functions, argument lists, recursion, lambda expressions

Code structurizing

- Modules and imports
- Packets

Object orientation

- Concept, notion of class, inheritance, static and private elements, abstract elements
- Standard methods, attributes, type checking, operator overloading

Libraries

- built-in libraries (selection)
- mathematics, strings, files, XML-files, numpy
- selection further libraries, e. g. scipy, matplotlib

Advances concepts

- context managers
- exceptions

Introduction to GUIs

Literature

http://docs.python.org/3
http://www.python-course.eu/python3_course.php
J. Ernesti, P. Kaiser; Python 3: Das umfassende Handbuch: Sprachgrundlagen, Objektorientierung, Modularisierung. Rheinwerk Computing 2015
Bernd Klein; Einführung in Python 3: Für Ein- und Umsteiger, Carl Hanser Verlag GmbH & Co. KG 2014
Thomas Theis; Einstieg in Python: Ideal für Programmieranfänger geeignet (Galileo Computing). Galileo Computing 2014

Examination

Method and Duration of Examination: schriftliche Prüfung 90 min + FrwL (0 % Bonus)

Energiespeicher

Modul

Module Name	Energiespeicher
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Oliver Bohlen

General Information about the Course

German Title	Energiespeicher
English Title	Energy Storage
Code	RM671 – Compulsory Subject
Semester	6
Frequency of C. Offer	normally every semester
Credit Points per Course	5
Course Coordinator	Dr. Oliver Bohlen
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	german
Degree Programs	RE/EM
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Oliver Bohlen (Modulverantw.), N.N.

Recommended Requirements

Physics, Fundamentals of Electrical Engineering

Module Objectives and Planned Learning Outcomes

The students are familiar with the most important storage technologies and can classify them in terms of their properties and assign them to different applications. They can calculate important parameters such as energy densities and power performance. Students can design battery systems using data sheets. They are familiar with measuring methods in the frequency and time domain and can practically implement and evaluate the latter. The students know simple electrical and thermal models of battery storage system as well as model-based diagnostic procedures and can implement them in a simulation environment and parameterize them.

Contents

Technological overview of various battery technologies, important parameters (energy density, power density, rated voltage, capacity), design of battery systems (series circuit, parallel circuit, conductivity, energy content, aging, cycle operation), use of batteries in various applications (stationary applications, traction applications, tools, and portable media), battery monitoring, and energy management (measuring devices, supervisory ICs, state of charge, state of health), battery diagnosis (measuring methods, test methods, impedance measurement, capacity measurement, standards), operation of energy storage systems (charging process, temperature management, safety aspects).

Literature

- Jossen, A., Weydanz, W., Moderne Akkumulatoren richtig einsetzen, Inge Reichardt Verlag, 2006
- Linden, D., Reddy, T. B. (ed.), Handbook of Batteries, McGraw-Hill Professional, 2001

Examination

Method and Duration of Examination: schriftliche Prüfung 90 min + FrwL (max. 10 % Bonus, Ergänzende Dokumentation zu den Inhalten des Moduls)

Analog Integrated Circuit Design

Modul

Module Name	Analog Integrated Circuit Design
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Michael Krämer

General Information about the Course

German Title	Analog Integrated Circuit Design
English Title	Analog Integrated Circuit Design
Code	WF033 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	normally in summer semester
Credit Points per Course	5
Course Coordinator	Dr. Michael Krämer
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	Englisch oder Deutsch
Degree Programs	EI/RE/EM/DS
Media	blackboard, video projector, e-learning

Lecturers

Dr. Michael Krämer (Modulverantw.), Prof. Dr. Christian Münker

Recommended Requirements

Basic knowledge of CMOS transistors, single stage transistor amplifiers and operational amplifiers, analysis methods for electrical networks, circuit simulation

Module Objectives and Planned Learning Outcomes

The students are able to understand, analyze, design, and verify integrated analog circuits based on CMOS transistors. This includes the complete design process, from simplified manual analysis of the circuit, through entering it into appropriate EDA software, simulating the circuit, creating the layout, to final verification (DRC, LVS, etc.) before tapeout in an integrated sub-micron CMOS technology. The students will become familiar with both the essential building blocks of modern integrated analog CMOS circuits (such as cascode stages, differential amplifiers, current mirrors, OTAs, bandgap references, etc.) and the typical design process based on open-source EDA software.

Contents

Analog Integrated Circuit Design:

- Introduction to the design flow for analog integrated circuits
- Presentation of the open-source toolchain
- Introduction to the exemplary 130nm Skywater CMOS process

Circuit Design / Basic Building Blocks:

- MOSFET transistors: large-signal and small-signal modeling, layout
- Basic amplifier circuits, cascode stage
- Passive and active current mirrors, OTAs

- Differential pair
- Operational amplifiers and operational amplifier architectures
- Current/voltage references (bandgap reference)
- Noise in electronic circuits

Integrated Realization of the Circuit:

- Layout and layout techniques
- Post-layout simulation / parasitic extraction
- Verification (DRC, LVS)
- Submission for fabrication (tapout)

Literature

Razavi, Behzad: „Design of Analog CMOS Integrated Circuits“, 2nd ed., 2017.

Examination

Method and Duration of Examination: Präsentation (50 %) und mündliche Prüfung (50 %, 20 min) + FrwL (max. 10 % Bonus, Ergänzende Dokumentation zu den Inhalten des Moduls)

Betriebsmittel und Diagnostik in der elektrischen Energietechnik

Modul

Module Name	Betriebsmittel und Diagnostik in der elektrischen Energietechnik
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Stephanie Uhrig

General Information about the Course

German Title	Betriebsmittel und Diagnostik in der elektrischen Energietechnik
English Title	Assets and Diagnostics in Power Engineering
Code	WF039 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr. Stephanie Uhrig
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	german
Degree Programs	EI/RE/EM/DS
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Stephanie Uhrig (Modulverantw.), N.N.

Recommended Requirements

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Module Objectives and Planned Learning Outcomes

The students have a sound knowledge of the basic electrical, dielectric, mechanical and thermal stresses and understand how these are taken into account within the design of equipment in power engineering. Furthermore, they have an overview of essential components of the power grid and can justify their stress-related designs and identify weak points. They are able to essentially design equipment for given boundary conditions. Students are familiar with diagnostic procedures for condition assessment of equipment and will be able to interpret their results.

Contents

Overview: Equipment in power engineering
o Differences in voltage levels
o Requirements regarding reliability and service life
Stresses on equipment
o Insulation coordination
o Long-term stable contacts (basics, models, contact aging)
o Mechanical stress
o Thermal stress
o Arc faults
Equipment
o Transformers (e.g. basic design, core designs, winding types and vector groups, insulation design, on-load tap-changers, bushings)
o Switchgear (construction, arrangement, differences with regard to voltage level)
o circuit breakers (based on arc quenching principles), as well as disconnectors and earthing switches
o Current and voltage transformers

o Surge arresters
o Overhead lines and cables
Diagnostics
o Definition of service life and introduction of aging mechanisms
o Dielectric measurement techniques such as tan delta measurements and dielectric spectroscopy
o Partial discharge measurement techniques
o Chemical analysis
o Frequency response analysis
Aspects of asset management
o Age structure in the German and European interconnected grid
o Reliability and risk assessment
o Maintenance strategies and consideration of economic efficiency

Literature

A. J. Schwab: Elektroenergiesysteme, Springer, 2022 D.
D. Oeding, B. R. Oswald: Elektrische Kraftwerke und Netze, Springer Vieweg, 2017
K. Heuck, K. Dettmann, D. Schulz: Elektrische Energieversorgung, Springer, 2013
S. Kämpfer, G. Kopatsch: ABB Schaltanlagen Handbuch, Cornelsen Verlag, 2012
G. Balzer, Ch. Schorn: Asset Management fur Infrastrukturanlagen - Energie und Wasser, Springer Vieweg, 2020

Examination

Method and Duration of Examination: mündliche Prüfung 20 min

Betriebssystem UNIX/Linux

Modul

Module Name	Betriebssystem UNIX/Linux
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Manfred Gerstner

General Information about the Course

German Title	Betriebssystem UNIX/Linux
English Title	Operating System UNIX/Linux
Code	WF020 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr. Manfred Gerstner
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	german
Degree Programs	EI/RE/EM/DS
Media	blackboard, video projector, e-learning

Lecturers

Dr. Manfred Gerstner (Modulverantw.), LbA Walter Tasin M. Sc.

Recommended Requirements

Basic programming capabilities (e.g. by Computer Engineering 1-3)

Module Objectives and Planned Learning Outcomes

Expertise

- Understanding of the basics, principles, working methods of Unix-like operating systems
- Know-how about distro selection, installation and configuration of a Linux system
- Programming skills for developing Linux based applications
- Productive work and profitable use of a Linux platform in everyday life
- Understanding of the application of Linux in the field of electrical engineering and beyond

Methodological competence

- Ability to analyze and solve problems in the field of software
- Knowledge of proven methods and procedures in the development of software, e.g. for the Raspberry Pi
- Ability to understand and implement complex technical concepts
- Efficient and ergonomic use of standard Unix tools

Social skills

- Teamwork and cooperation with other students in projects
- Communication skills to exchange ideas and technical knowledge
- Ability to present technical concepts and results in an understandable way
- Ability to give constructive feedback and collaborate in a learning community
- Respectful collaboration and cultural sensitivity in dealing with different backgrounds and perspectives

Self-competence

- Time management and effective organization of one's own learning process
- Ability to independently acquire knowledge and work independently
- Meeting deadlines and taking responsibility for completing tasks

Contents

1. Structure and methods of operating systems; Unix, Linux, distros
2. first steps with command line interface, getting help (–help, man-pages)
3. File systems from user perspective, from OS perspective; roles, rights, user administration; Devices in /dev
4. Process management, memory isolation, time slots, scheduling, IPC
5. bashscript (if, while, for,...) variables, path expansion, regular expressions
6. Miscellaneous, e.g. boot process, systemd, IT security, archiving and backup strategies, selection, installation and set up of distros

Literature

Linus Torvalds: Just for Fun, Hanser-Verlag
A. Achilles: *Betriebssysteme: Eine Kompakte Einführung mit Linux*, eXamen.press, 2005
W. Stallings: *Operating Systems: Internals and Design Principles*, Global Edition, 2017
M. Hausenblas: *Learning Modern Linux: A Handbook for the Cloud Native Practitioner*, O'Reilly, 2022
J. Friedl: *Mastering Regular Expressions*, O'Reilly, 2006
J. Goyvaerts, S. Levithan: *Regular Expressions Cookbook: Detailed Solutions in Eight Programming Languages*, 2012

Examination

Method and Duration of Examination: schriftliche Prüfung 90 min oder mündliche Prüfung 20 - 30 min

Business and Technical English in Electrical Engineering

Modul

Module Name	Business and Technical English in Electrical Engineering
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Nicole Brandstetter

General Information about the Course

German Title	Business and Technical English in Electrical Engineering
English Title	Business and Technical English in Electrical Engineering
Code	WF036 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr. Nicole Brandstetter
Hours per Week	4
Teaching Method	Seminar (mit z.B. Präsentationen/Referaten) (4 S)
Workload	56 S + 94 preparation/post-processing = 150 hours
Language	english
Degree Programs	EI/RE/EM/DS
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Nicole Brandstetter (Modulverantw.), Ana Schaumburger

Recommended Requirements

Knowledge of English at level B1

Module Objectives and Planned Learning Outcomes

- Professional competence

  Upon completion of that course, students are able to communicate confidently in English in various situations of their future professional life. For that purpose they enhance their oral and written communication skills by training how to use English in business contexts correctly according to the situation and to the audience (level B2).

- Methodological competence

  Students are able to explore new lexical fields and topics and to reflect their own learning process on a methodological basis. Thereby students get to know strategies to avoid mistakes in using English.

- Self-competence

  Students compare their conduct in various communicative situations and consequently discuss strategies of handling those situations professionally. In addition, they enhance their written competence in English.

- Social competence

  Students verbalise topics adequately and present results confidently with regard to the context and the audience.

Contents

In this seminar students train their oral competence in English in various communicative situations (formal introductions, small talk, social English, job interview, telephone calls). Furthermore, they practise how to write technical

instructions, process descriptions and different forms of professional business correspondence (emails, memos) according to the given situation. For that purpose, necessary grammatical structures and specific vocabulary and expressions are trained. Moreover, students learn how to put together successfully their individual documents for a job application (CV, covering letter) and thereby get to know different corporate structures.

Literature

- Nachschlagewerke zur englishen Sprache

  Longman Business English Dictionary. Longman, 2007

  Oxford Advanced Learner's Dictionary. Oxford University Press, 2015

  Oxford Business English Dictionary. Oxford University Press, 2005

- Fachliteratur zur englishen Sprache

  Business Spotlight. Planegg: Spotlight Verlag

  Duckworth, Michael. Business Grammar & Practice. Oxford: Oxford UP, 2013

  Emmerson, Paul. Business English Vocabulary Builder. The words & phrases you need to succeed. London: Macmillan, 2009

  Emmerson, Paul. Business English Grammar Builder. Second Edition. Clear explanations for real situations. London: Macmillan, 2010

  Ibbotson, Mark. Cambridge English for Engineering. Cambridge: Cambridge UP, 2008

  Ibbotson, Mark. Professional English in Use. Cambridge: Cambridge UP, 2010

  McCarten, Jeanne; McCarthy, Michael. Grammar for Business. Stuttgart: Klett, 2010

  Murphy, Raymond. English grammar in use: A self-study reference and practice book for intermediate students. Cambridge: Cambridge University Press, 2012

  Strutt, Peter. Market Leader – Essential Business Grammar and Usage. Harlow: Pearson Education Limited, 2010

  Ungerer, F.; Meier, G. E. H.; Schäfer, K.; Lechler, S. B. A Grammar of Present-Day English. Stuttgart: Klett, 2009

Examination

Method and Duration of Examination: Modularbeit (50 %, E-Portfolio gemäß Vorgabe zu Semesterbeginn) + mündliche Prüfung 20 min (50 %)

Fakultätsübergreifendes interdisziplinäres Projekt

Modul

Module Name	Fakultätsübergreifendes interdisziplinäres Projekt
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. habil. Norbert Geng

General Information about the Course

German Title	Fakultätsübergreifendes interdisziplinäres Projekt
English Title	Multidisciplinary Project Across Several Faculties
Code	WF035 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr. habil. Norbert Geng
Hours per Week	4
Teaching Method	project-based course (4 Proj)
Workload	150 Proj = 150 hours
Language	german
Degree Programs	EI/RE/EM
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. habil. Norbert Geng (Modulverantw.), Dr. Simon Schramm, Dr. Stephanie Uhrig, Dr. Georg Kerber

Recommended Requirements

Project Management, Fundamentals of Semester 1-4

Module Objectives and Planned Learning Outcomes

The students deepen their knowledge in the field of electrical engineering as well as in the area of project management by working on a specific task within a larger technical project.
The students are able to plan a project in the field of electrical engineering or adjacent technical areas using appropriate methods, to realize technical solutions and to present the results, taking into account non-technical boundary conditions if necessary. They are able to deal with a technical problem using appropriate methods, if necessary interdisciplinary and work-sharing in the team.
Due to the interdisciplinary offer, students are also able to work with non - electrical technicians in a technical project.

Contents

The „Interdisciplinary Teaching Project“ takes place as a project across faculty boundaries with students from various technical and non-technical faculties of the Hochschule München (HM). It is supervised by professors of the HM. Further details about the content of the project, the resulting tasks and also the examination mode can be obtained from the teachers of the relevant teaching project.
The chosen teaching format is characterized by the fact that students are taught competencies through problem-oriented learning at practice-oriented and interdisciplinary tasks.
Important instructions:
The offer of interdisciplinary teaching projects will be announced university-wide in time before the beginning of the semester.
The project can in principle be chosen in any semester. A credit to the Bachelor's certificate is currently only provided in the semesters 6/7 as a WP2 module.

In order to be able to ensure the (electrical) technical reference of the assignment within the teaching project, a permission from the examination board is required if the teaching project is to be counted as a WP2 module (replacing one of the other possible WP2 modules).

Literature

abhängig vom konkreten Projekt

Examination

Method and Duration of Examination: nach Vorgabe der Prüfer:innen (z.B. Modularbeit, Präsentation, mündliche Prüfung)

Labor-Projekt

Modul

Module Name	Labor-Projekt
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. habil. Norbert Geng

General Information about the Course

German Title	Labor-Projekt
English Title	Laboratory Project
Code	WF034 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	normally every semester
Credit Points per Course	5
Course Coordinator	Dr. habil. Norbert Geng
Hours per Week	4
Teaching Method	project-based course (4 Proj)
Workload	150 Proj = 150 hours
Language	german/english
Degree Programs	EI/RE/EM
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. habil. Norbert Geng (Modulverantw.), Dr. Joachim Schramm, Dr. Arne Striegler, LbA Walter Tasin M. Sc.

Recommended Requirements

Project Management, Fundamentals of Semester 1-4

Module Objectives and Planned Learning Outcomes

The students deepen their knowledge in the field of electrical engineering as well as the area of project management by working on a specific task within a larger technical project.
Through their participation in a larger research project, students get familiar with scientific methods.
The students are able to plan a project in the field of electrical engineering or neighboring areas using appropriate methods, to realize technical solutions and to present the results, taking into account non-technical boundary conditions if necessary. They are able to deal with a technical problem with appropriate methods, if necessary interdisciplinary and work-sharing in the team.
By working together with the other project participants, the students improve their competence for communication in the team.

Contents

The laboratory project takes place in a laboratory of FK04 and is supervised by a faculty professor. The topic is defined by the supervising professor, and in many cases is a partial aspect of a larger R & D project. Even if the R & D project is carried out in cooperation with external partners, the work within the framework of this module has to take place in the laboratories of the university.
The task is defined by the spectrum of the technical focus and R & D projects of the faculties' laboratories and enables the students to apply and deepen their knowledge with appropriate guidance by the supervisor. In this way, the students are enabled to work independently on the problem solution together with others. The laboratory project is based on the usual practice in the industrial environment when dealing with complex complex tasks.
The laboratory project is a module, which is included in the list of the so-called WP2 modules (compulsory modules) (see study plan), which is equivalent to the other WP2 modules.

Literature

Geeignete Fachliteratur abhängig vom konkreten Projekt (Hinweise des Dozenten oder Literatursuche im Internet bzw. in der Bibliothek).
Schelle Heinz, Projekte zum Erfolg führen - Projektmanagement systematisch und kompakt, München, Dt. Taschenbuch-Verlag, 2010
Jenny Bruno, Projektmanagement - das Wissen für den Profi, Zürich, vdf, Hochschulverlag an der ETH Zürich
Roger P. Wormwood: The World Before the Internet and Other Frightening Tales,
Paris (Texas), SNAFU Publishing Group, 2009

Examination

Method and Duration of Examination: Modularbeit + Präsentation, gemäß Vorgaben beim Projektstart

Network Security

Modul

Module Name	Network Security
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	

General Information about the Course

German Title	Network Security
English Title	Network Security
Code	WF009 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	Englisch
Degree Programs	EI/RE/EM/DS
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

(Modulverantw.), N.N.

Recommended Requirements

fundamental programming skills (e.g. from Computer Engineering 1-3), English Workshop

Module Objectives and Planned Learning Outcomes

Provides detailed knowledge of network security, the fundamentals of cryptography, and the possibilities and limitations to ensure the various security requirements in communication. Possible weaknesses of networks are shown from a hackers perspective. The students are then able to draw conclusions about the possibilities of designing secure products and networks, build them up accordingly and explain the results.

Contents

security-requirements, fundamentals of cryptography, identification and authentication, PKI (public key infrastructures), attack methodology and scenarios, computer and network security, software reliability, risk analysis, design of protective measures.
Recommended special requirements: TCP / IP knowledge, protocol analysis, basics of network administration, routing and firewalls (corresponds to the first part of the lecture computer networks, which can be visited in parallel).

Literature

Caswell, Hewlett; Snort Users Manual, www.snort.org
Fyodor; nmap Documentation, http://www.insecure.org/nmap.html
Gerloni et.al; Praxisbuch für Linux-Server und -Netze; Hanser Verlag
Kyas, a Campo; IT-Crackdown, Sicherheit im Internet, mitp Verlag
Nash et. al; PKI, E-Security implementieren, mitp Verlag
Northcutt et. al; Inside Network Perimeter Security, New Riders
Northcutt, Novak; Network Intrusion Detection, New Riders

Peterson, Davie; Computer Networks, Morgan Kaufman, dt. Ausgabe bei Dpunkt
Plate; Sicherheit in Computernetzen, http://www.netzmafia.de/skripten/index.html
Russell et. al; Hack Proofing Your Network: Internet Tradecraft, syngress Publishing
Schneier; Secrets and Lies, John Wiley and Sons, dt. Ausgabe bei DPunkt
Schneier; Applied Cryptography, John Wiley and Sons, dt. Ausgabe bei Addison Wesley

Examination

Method and Duration of Examination: schriftliche Prüfung 60 min

Projekt Autonome Systeme

Modul

Module Name	Projekt Autonome Systeme
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. habil. Alfred Schöttl

General Information about the Course

German Title	Projekt Autonome Systeme
English Title	Project on Autonomous Systems
Code	WF013 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr. habil. Alfred Schöttl
Hours per Week	4
Teaching Method	project-based course (4 Proj)
Workload	150 Proj = 150 hours
Language	german
Degree Programs	EI/RE/EM
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. habil. Alfred Schöttl (Modulverantw.), N.N.

Recommended Requirements

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Module Objectives and Planned Learning Outcomes

The students intensify the knowledge and skills of the following areas depending on their specific project task:

- they are able to design, implement and test a robotic software application
- they are able to design and construct (simple) mechanical components
- they are able to integrate electronic components, design adaptors and implement drivers
- they are able to analyze technical tasks and design hardware and software specifications
- they are able to utilize appropriate development and simulation tools for their task

The students practice the interdisciplinary communication by the cross-department teams. The independent team work fosters self-responsibility. The students give a presentation at the end of the project in which technical and non-technical aspects, such as logistical or economical constraints as well as work organization, have to be taken into account.

Contents

Development of components of autonomous robots and related systems. The work is performed in project teams, which are assigned at the beginning of the semester. The tasks have various core topics taken from the area software, electronics hardware/interfaces and mechanics/mechatronics. All topics comprise the aspects planning, design, implementation and test. The results are demonstrated, ideally in a robotic application. Most used or developed robotic systems utilize the robotics framework ROS; the software- or interface-related tasks are therefore a good opportunity to obtain an introduction to ROS. Subsequent tasks are possible.

Literature

abhängig von der konkreten Projektaufgabe

Examination

Method and Duration of Examination: Modularbeit (50 %) + Präsentation (50 %), gemäß Vorgaben zu Semesterbeginn

Projekt Elektrische Fahrzeugantriebe

Modul

Module Name	Projekt Elektrische Fahrzeugantriebe
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr.-Ing. Christoph M. Hackl

General Information about the Course

German Title	Projekt Elektrische Fahrzeugantriebe
English Title	Project on Electric Automotive Drives
Code	WF014 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr.-Ing. Christoph M. Hackl
Hours per Week	4
Teaching Method	project-based course (4 Proj)
Workload	150 Proj = 150 hours
Language	german
Degree Programs	EI/RE/EM
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr.-Ing. Christoph M. Hackl (Modulverantw.), Dr. Herbert Palm, Dr. Dirk Hirschmann, Dr. Oliver Bohlen, Dr. Ulrich Unterhinninghofen

Recommended Requirements

Fundamentals of Semester 1-4, Project Management

Module Objectives and Planned Learning Outcomes

The students deepen their knowledge in the field of electrical engineering as well as in the area of project management through the practical application of the knowledge gained in the previous semesters.
Students are able to analyze complex tasks and to design solution strategies based on them. They can derive specific solutions from the solution strategy and implement them independently. They are trained in interdisciplinary communication with students of other faculties. In specialist talks or presentations they can reflect the level of knowledge of their conversational partner or listener and arrange the conversation or the presentation in such a way that the essential aspects of the special topics are comprehensible for all participants.
Depending on the specific task, the students deepen their specialist competencies in a topic in the field of electrical vehicle drives and electromobility (eg design and construction of drive systems, analysis and evaluation of existing solutions).

Contents

Students collaborate in project teams on different topics in the field of electric drives for vehicles and electric mobility. Various tasks are presented at the beginning of the semester and assigned to the project groups. These tasks belong to university projects for vehicle development (for example, the „Formula Student Electric“, the project „Porsche SE Boxster“ or the „Shell Eco Marathon“) or their environment (e.g. charging stations).

Literature

- Hybrid-, Batterie- und Brennstoffzellen-Elektrofahrzeuge - Technik, Strukturen und Entwicklungen. Renningen, expert-Verlag, 2007

- Homepage des HM-Teams des Shell-Eco-Marathon: http://www.hydro2motion.de
- Homepage des HM-Teams der Formula Student: www.munichmotorsport.de

Examination

Method and Duration of Examination: Modularbeit (50 %) + Präsentation (50 %), gemäß Vorgaben zu Semesterbeginn

Regenerative Energien

Modul

Module Name	Regenerative Energien
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Simon Schramm

General Information about the Course

German Title	Regenerative Energien
English Title	Renewable Energies
Code	RE695 – Compulsory Subject
Semester	6/7
Frequency of C. Offer	normally in summer semester
Credit Points per Course	5
Course Coordinator	Dr. Simon Schramm
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	german
Degree Programs	RE,DS
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Simon Schramm (Modulverantw.), N.N.

Recommended Requirements

Physics, Fundamentals of Electrical Engineering, Energy Conversion

Module Objectives and Planned Learning Outcomes

Contents

- Energy and Environment – "Sensitivity"
- Hydropower, wave energy,...
- Solar Energy Meteorology
- Physical basics of photovoltaics, photovoltaic system technology for grid-connected photovoltaic systems
- Solar thermal residential systems and solar thermal concentrating systems
- Wind turbines fundamentals, wind turbine system technology
- System design for stand-alone systems

Literature

- Olimpo Anaya-Lara, „Wind Energy Generation – Modeling and Control", Wiley, 2009
- Quaschning, „Regenerative Energiesysteme", Hanser Verlag, 2013
- Heier S. „Windkraftanlagen", Springer Verlag, 2006

Examination

Method and Duration of Examination: schriftliche Prüfung 90 min + FrwL (max. 10 % Bonus, Ergänzende Dokumentation zu den Inhalten des Moduls)

Simulation regenerativer Energiesysteme

Modul

Module Name	Simulation regenerativer Energiesysteme
Module Level	Bachelor
Credit Points per Module	5
Module Coordinator	Dr. Oliver Mayer

General Information about the Course

German Title	Simulation regenerativer Energiesysteme
English Title	Simulation of Renewable Energy Systems
Code	WF018 – Required Elective Subject
Semester	6/7
Frequency of C. Offer	abhängig vom Bedarf, kein fester Turnus
Credit Points per Course	5
Course Coordinator	Dr. Oliver Mayer
Hours per Week	4
Teaching Method	Seminaristischer Unterricht mit integriertem lab exercise (3 SU + 1 Pra)
Workload	42 SU + 14 Pra + 94 preparation/post-processing = 150 hours
Language	german
Degree Programs	EI/RE/EM/DS
Media	blackboard, flipchart, overhead projector, video projector, e-learning

Lecturers

Dr. Oliver Mayer (Modulverantw.), Dr. Oliver Mayer

Recommended Requirements

Fundamentals of Semester 1-4

Module Objectives and Planned Learning Outcomes

Understanding the basics of simulation generally, simulation techniques and simulation models specifically for renewable energy systems, knowledge of the limits of simulations.
Ability to solve complex problems in the field of renewable energy by means of simulation and to interpret and present the results. In small student projects the communication between the students and the competence for the presentation of project results is encouraged.

Contents

Basics of simulation technology, development of simulation models for renewable energy systems, comparison of simulation methods, methods for renewable energy systems, presentation of various renewable simulation programs with background info for development, projects as workshop (Student project teams run on their own project tasks), presentation and discussion of project results.

Literature

Volker Quaschning; Regenerative Energiesysteme; Hanser Verlag

Examination

Method and Duration of Examination: schriftliche Prüfung 90 min (50 %) + Präsentation 20 min (50 %)