Course Handbook Electrical Engineering and Information Technology Bachelor

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Electrical Engineering and Information Technology Bachelor - mandatory courses (overview)

Module name (EN)	Code	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Application-Specific Integrated Circuits	E2611	6	2V+1U	3	Prof. Dr. Volker Schmitt
Bachelor Colloquium	E2703	7	-	3	Dozenten des Studiengangs
Bachelor Thesis	E2702	7	-	12	Dozenten des Studiengangs
Business Communication for Electrical Engineers	E2306	3	1V+1U	2	Prof. Dr. Christine Sick
Business Correspondence and Applying for an Engineering Job	E2409	4	1V+1U	2	Prof. Dr. Christine Sick
CAD in Microelectronics	E2408	4	3V+1U+1PA	6	Prof. Dr. Albrecht Kunz
Control Engineering and its Applications	E2604	6	2V+1U	4	Prof. Dr. Benedikt Faupel
Decentralized Electric Power Systems and Energy Storage Facilities	E2608	6	4V+2P	7	Prof. Dr. Michael Igel
Design in Electrical Engineering	E2205	2	2V+2PA	5	Studienleitung
Designing Digital Transmission Systems	E2609	6	2V+1P	4	Prof. Dr. Martin Buchholz
Digital Electronics	E2105	1	2V+1U+1P	5	Prof. Dr. Albrecht Kunz
Digital Signal Processing	E2510	5	2V+2P	5	Prof. Dr. Martin Buchholz
Electric Power Supply Systems 1	E2506	5	3V+1U	5	Prof. Dr. Michael Igel
Electric Power Supply Systems 2	E2606	6	3V+1U	4	Prof. Dr. Michael Igel
Electrical Engineering Theory 1	E2304	3	2V+1U	5	Prof. Dr.-Ing. Dietmar Brück

Electrical Machines 1	E2507	5	2V+1U+1P	4	Prof. Dr.-Ing. Stefan Winternheimer
Electrical Machines 2	E2607	6	2V+1U+1P	4	Prof. Dr.-Ing. Stefan Winternheimer
Electronics 1	E2303	3	3V+2U	5	Prof. Dr. Volker Schmitt
Electronics 2	E2401	4	3V+1U+2P	7	Prof. Dr. Volker Schmitt
Engineering Mathematics 1	E2101	1	5V+2U	8	Prof. Dr. Gerald Kroisandt
Engineering Mathematics 2	E2201	2	5V+2U	8	Prof. Dr. Gerald Kroisandt
Engineering Mathematics 3	E2301	3	3V+1U	5	Prof. Dr. Gerald Kroisandt
Engineering Tools	E2307	3	2V	2	Prof. Dr. Martin Buchholz
Fundamentals of Electrical Engineering 2	E2204	2	4V+1U+1P	7	Prof. Dr. Marc Klemm
Fundamentals of Energy Systems	E2403	4	5V+1U	6	Prof. Dr.-Ing. Stefan Winternheimer
Fundamentals of High-Voltage Engineering and Test Engineering	E2605	6	2V+1U+1P	5	Prof. Dr. Marc Klemm
Fundamentals of Information Technology	E2411	4	4V	5	N.N.
High and Ultra-High Frequency Engineering	E2512	5	4V+1U	6	Prof. Dr. Martin Buchholz
Industrial Control Technology	E2404	4	2V+1U+1P	5	Prof. Dr. Benedikt Faupel
Information Technology - Lab Course	E2513	5	5P	6	Prof. Dr. Horst Wieker
Information Technology and Systems 1	E2407	4	3V	4	Prof. Dr. Horst Wieker
Information Technology and Systems 2	E2511	5	4V	5	Prof. Dr. Horst Wieker

Integration-Compatible Circuitry	E2610	6	2V+2PA	5	Prof. Dr. Albrecht Kunz
Laboratory Course in Automation Engineering	E2603	6	8P	8	Prof. Dr.-Ing. Dietmar Brück
Measurement and Instrumentation Engineering 1	E2203	2	2V+2P	5	Prof. Dr. Oliver Scholz
Measurement and Instrumentation Engineering 2	E2302	3	2V+2P	5	Prof. Dr. Oliver Scholz
Microcontrollers and Applications 1	E2501	5	2V+1P	4	Prof. Dr.-Ing. Dietmar Brück
Microcontrollers and Applications 2	E2601	6	2V+2P	5	Prof. Dr.-Ing. Dietmar Brück
Microelectronics Lab Course	E2613	6	5P	5	Prof. Dr. Volker Schmitt
Physics 2	E2202	2	4V+1U	5	Prof. Dr.-Ing. Barbara Hippauf
Physics1	E2102	1	4V+1U	5	Prof. Dr.-Ing. Barbara Hippauf
Power Electronics and Drive Systems Engineering	E2505	5	2V+1U+1P	5	Prof. Dr.-Ing. Stefan Winternheimer
Power Electronics and Drive Systems Engineering	E2602	6	2V+1U+1P	5	Prof. Dr.-Ing. Stefan Winternheimer
Procedural Programming with C / C++	E2305	3	4V+2U	7	Prof. Dr. Reinhard Brocks
Process Automation	E2503	5	4PA	4	Prof. Dr. Benedikt Faupel
Programming Microcontrollers	E2509	5	4V	5	Prof. Dr.-Ing. Jürgen Schäfer
Programming Tools for Automation Solutions	E2412	4	1V+1U	3	Prof. Dr. Benedikt Faupel
Project Management	E2103	1	2V+2U	5	Prof. Dr.-Ing. Stefan Winternheimer
Project Work	E2614	6	-	5	N.N.

Signal and Image Processing	E2504	5	3V+1U	5	Prof. Dr.-Ing. Dietmar Brück
Signal and Systems Theory	E2405	4	3V+1U	5	Prof. Dr. Martin Buchholz
Smart Grids and Distributed Generation	E2410	4	2V+2P	5	Prof. Dr. Michael Igel
System Theory and Control Engineering 1	E2402	4	2V+2U	5	Prof. Dr. Benedikt Faupel
System Theory and Control Engineering 2	E2502	5	2V+2U	5	Prof. Dr. Benedikt Faupel
Technical English for Electrical Engineers and Professional Presentations	E2508	5	1V+1U	2	Prof. Dr. Christine Sick
Telecommunication Systems	E2406	4	3P+2S	6	Prof. Dr. Albrecht Kunz
Telecommunications Technology Lab Course	E2612	6	1V+4P	6	Prof. Dr. Martin Buchholz
Work Experience Phase	E2701	7	-	14	Dozenten des Studiengangs

(58 modules)

Electrical Engineering and Information Technology Bachelor - optional courses (overview)

Module name (EN)	Code	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Applications in Telecommunications	E2570	5	2V	3	Prof. Dr. Martin Buchholz
French for Beginners II	E2423	-	2V	2	Prof. Dr. Christine Sick
Fundamentals of Programming Using NI LabVIEW	E2531	5	1V+1U	2	Prof. Dr.-Ing. Bernd Valeske
Introduction to Wireless LANs	E2428	-	2V	3	Dipl.-Math. Wolfgang Braun
Methods and Applications of Artificial Intelligence for Signal and Image Processing	E2542	5	4PA	8	Prof. Dr.-Ing. Ahmad Osman
Oral and General Presentation Skills in the Engineering Sciences	E2581	5	1V+1U	2	Dr. Peter Ludwig
Problem Solving Technology and Decision Making	E2583	5	1V+1U	2	Prof. Dr.-Ing. Stefan Winternheimer
Russian for Beginners 2	E2427	-	2SU	2	Prof. Dr. Christine Sick
Spanish for Beginners I	E2424	-	2V	2	Prof. Dr. Christine Sick
Spanish for Beginners II	E2425	-	2V	2	Prof. Dr. Christine Sick
Systems Engineering	E2572	5	2PA	3	Prof. Dr. Martin Buchholz
Technical Documentation	E2580	5	2V	2	Prof. Dr. Walter Calles
Using Microcontroller Technology	E2540	5	2PA	2	Prof. Dr.-Ing. Dietmar Brück

(13 modules)

Electrical Engineering and Information Technology Bachelor - mandatory courses

Application-Specific Integrated Circuits

Module name (EN): Application-Specific Integrated Circuits
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2611
Hours per semester week / Teaching method: 2V+1U (3 hours per week)
ECTS credits: 3
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Oral examination
Curricular relevance: E2611 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 45 class hours (= 33.75 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 56.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Volker Schmitt
Lecturer: Prof. Dr. Volker Schmitt [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to explain the logical concepts of programmable digital circuits and identify the different technologies in terms of storage and physical programming and their essential characteristics. They will be able to assign architectures and technologies to the various types of programmable digital circuits. They will be familiar with the characteristics and technologies of other special application-specific integrated circuits. Students will be familiar with important design rules for digital circuits and be able to explain why these must be complied with. They will be capable of playing a key role in deciding whether to use certain technologies to solve specific development tasks. Students will be able to use their knowledge about the hardware description language VHDL to independently design and test digital circuits and systems with the help of a suitable simulation tool. [*updated 08.01.2020*]

Module content:
- An overview of monolithic integrated circuits, semi-custom, full-custom, areas of application, - Programmable digital circuits, PROM, PLD, PLA, PAL, selected CPLD families, selected FPGA families, architectural features, programming technologies, - Gate arrays, sea of gates, standard cells, - Design rules for digital circuits, delay lines, process parameters, synchronous and asynchronous circuits, glitches, - Programmable integrated analog circuits, architectural features, programming technologies, - Transistor arrays, analog full-custom circuits - Introduction to the hardware description language VHDL - Input options: text editor, schematic editor, display of results, - Description of digital components and systems with VHDL, structure of VHDL models, basic structures, properties, - Language elements, declarations, object classes, entity, architecture, process, procedure, function, package, block,
- Concurrent and sequential instructions, code execution, time models, libraries, - Structured designs, hierarchy, synthesis,

[*updated 08.01.2020*]

Teaching methods/Media:
Templates and task sheets in electronic form, PC, projector, VHDL simulation tool

[*updated 08.01.2020*]

Recommended or required reading:
Ashenden, Peter J.; Peterson, Gregory D.; Teegarden, Darrell A.: The system designer"s guide to VHDL-AMS, Morgan Kaufmann, 2003, ISBN 1-55860-749-8 Badach, Anatol: Voice over IP - die technik, Hanser, 2007, 3. Aufl. Christiansen, Peter: Rechnergestütztes Entwickeln integrierter Schaltungen, Vogel, 1989 Hertwig, Andre; Brück, Rainer: Entwurf digitaler Systeme, Hanser, 2000, ISBN 978-3446214064 Hervé, Yannick: VHDL-AMS, Anwendungen und industrieller Einsatz, Oldenbourg, 2006 Kemper, Axel; Meyer, Manfred: Entwurf von Semicustom Schaltungen, Springer, 1989 Reichardt, Jürgen; Schwarz, Bernd: VHDL-Synthese, Oldenbourg, (latest edition) Reifschneider, Nobert: CAE-gestützte IC-Entwurfsmethoden, Prentice Hall, 1998 Siegl, Johann; Eichele, Herbert: Hardwareentwicklung mit ASIC, Hüthig, 1990 Siemers, Christian: Hardwaremodellierung, Hanser, 2000, ISBN 3-446-21361-9 TenHagen, Klaus: Abstrakte Modellierung digitaler Schaltungen, Springer, 1995, ISBN 3-540-59143-5

[*updated 08.01.2020*]

Bachelor Colloquium

Module name (EN): Bachelor Colloquium
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2703
Hours per semester week / Teaching method: -
ECTS credits: 3
Semester: 7
Mandatory course: yes
Language of instruction: German
Assessment: Seminar presentation
Curricular relevance: E2703 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 7, mandatory course
Workload: The total student study time for this course is 90 hours.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Dozenten des Studiengangs
Lecturer: Dozenten des Studiengangs [*updated 10.09.2018*]
Learning outcomes: During the colloquium, students will be given the opportunity to present and discuss their thesis topic within a given time frame with an audience of experts. [*updated 08.01.2020*]
Module content: [*still undocumented*]
Recommended or required reading: [*still undocumented*]

Bachelor Thesis

Module name (EN): Bachelor Thesis

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2702

Hours per semester week / Teaching method: -

ECTS credits: 12

Semester: 7

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
E2702 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 7, mandatory course

Workload:
The total student study time for this course is 360 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dozenten des Studiengangs

Lecturer: Dozenten des Studiengangs

[*updated 10.09.2018*]

Learning outcomes:
Independent development of a project from the field of research and development. With their thesis,students will prove that they are capable of successfully working on and presenting an application-oriented problem from their specific subject area within a given time frame while applying the engineering methods they have learned in a structured manner.

[*updated 08.01.2020*]

Module content:
If possible, the thesis should be developed in cooperation with an industry partner or as part of a research project. In it, students should apply the knowledge acquired during their studies to a concrete and application-oriented task. Students will have a period of 3 months to complete their thesis. The thesis can be written in a language other than German with the consent of the respective thesis supervisor.

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Business Communication for Electrical Engineers

Module name (EN): Business Communication for Electrical Engineers
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2306
Hours per semester week / Teaching method: 1V+1U (2 hours per week)
ECTS credits: 2
Semester: 3
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2306 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Christine Sick
Lecturer: Miriam Wedig, M.A. (lecture) [*updated 18.07.2019*]
Learning outcomes: The three English modules are to be seen in conjunction with one another. They provide students with a framework in which to develop their job-related English language skills from the entry level B1 to level B2. This module focuses on oral communication skills for electrical engineers. After successfully completing this course, students will have insight into the differences between international working environments, in particular English-speaking ones, and will be able to describe professional tasks. They will be able to recognize difficulties and conflicts in intercultural communication situations and draw conclusions for their own behavior in international contexts. This will enable them to use the right communicative means of speech and behavior in various oral communication situations. [*updated 08.01.2020*]

Module content:
- Greetings, introducing oneself, small talk - Describing your career, activities and company - Making appointments- Making phone calls in a professional context - Understanding and writing (telephone) notes In addition: - Vocabulary - Repetition of the relevant grammatical structures - Raising awareness for the functional use of language - Intercultural aspects

[*updated 08.01.2020*]

Teaching methods/Media:
Teaching and learning materials (print, audio, video), multimedia teaching and learning software for specific target groups

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Business Correspondence and Applying for an Engineering Job

Module name (EN): Business Correspondence and Applying for an Engineering Job
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2409
Hours per semester week / Teaching method: 1V+1U (2 hours per week)
ECTS credits: 2
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2409 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Christine Sick
Lecturer: Miriam Wedig, M.A. (lecture) [*updated 18.07.2019*]

Learning outcomes:
The three English modules are to be seen in conjunction with one another. They provide students with a framework in which to develop their job-related English language skills from the entry level B1 to level B2. This module focuses on written business correspondence, as well as job applications. After successfully completing this module, students will be able to communicate with international business partners by e-mail or letter. They will be familiar with the typical structure of the above, be sensitive to different registers and can apply these adequately. In addition, they will have a command of numbers and technical specifications in writing. Students will be able to describe various professional fields that are suitable for them as graduates of the Bachelor´s program. They will be able to write their own profile and apply as an engineer for a job advertisement written in English at an international company. They will be able to prepare application documents, i.e. CV and cover letter, and apply interview strategies. Cultural differences will also be taken into account.

[*updated 08.01.2020*]

Module content:
I. Business correspondence Typical documents from the field of business Reading and writing business letters from the resp. professional field Reading and writing e-mails Distinction between formal and informal business language II. Job applications Description of typical occupational fields in the energy supply and renewable energy sector Describing your own profile, including your professional background, technical knowledge and skills, soft skills Reading job advertisements Writing an application letter Writing a CV Preparing and training for an interview In addition: - Vocabulary - Repetition of the relevant grammatical structures

[*updated 08.01.2020*]

Teaching methods/Media:
Teaching and learning materials (print, audio, video), multimedia teaching and learning software for specific target groups

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

CAD in Microelectronics

Module name (EN): CAD in Microelectronics
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2408
Hours per semester week / Teaching method: 3V+1U+1PA (5 hours per week)
ECTS credits: 6
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Term paper (50%), seminar presentation (50%)
Curricular relevance: E2408 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 75 class hours (= 56.25 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 123.75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): E2302 Measurement and Instrumentation Engineering 2 E2303 Electronics 1 [*updated 18.07.2019*]
Recommended as prerequisite for: E2610 Integration-Compatible Circuitry [*updated 18.07.2019*]
Module coordinator: Prof. Dr. Albrecht Kunz
Lecturer: Prof. Dr. Albrecht Kunz [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will become familiar with the many possibilities of circuit simulation at the component level by using an integrated design environment for circuit analysis and design. They will also make use of the modification options offered by the simulation tool to adapt it to their own special requirements. Students will be able to independently design electronic circuits in the low frequency range and test them in simulations. Within the framework of the tutorial and the project, students will plan various electronic circuits on a printed circuit board in small groups. They will use EDA software to create the necessary layout. To do so, they will apply their knowledge about enclosure and assembly technology, connection technology and layout rules in order to obtain a production-ready, functional design. Students will hold a presentation in which they will present the results of their group work in a well-structured, comprehensible and appealing way. They will write a term paper in the style of a technical report. In it they will document the process from the design of the circuit, to simulation tests and the final version of the circuit board in a clear and concise manner.

[*updated 08.01.2020*]

Module content:
- General information on system and circuit design, specification sheet, specifications, design levels and forms of representation, bottom-up method, top-down method, Designing microelectronic systems - Introduction to the integrated design environment of the simulation tool being used, schematic editor, graphical result display, stimulus editor, parameter extractor, file types, net list, analysis types, simulator instructions, simulator settings, - Analog and digital network elements, models, sub-circuits, analog and digital behavior description, macro modeling, - Simulation of mixed digital analog circuits, interfaces between analog and digital circuit parts - Exercises for handling the simulation tool used in the course The structure of microelectronic systems - Connection technology, enclosure and assembly technology, hybrid circuits, printed circuit boards in SMT - SMT component and enclosure forms, types of packaging and delivery, solderability and storage, - Printed circuit board production, laminate materials, prepregs, presses - Chip on Board (COB), chip assembly, die bonding, eutectic alloys, bonding, Tape Automated Bonding (TAB), wire bonding, bond defects, ultra-fine wires, gap welding, - Creating circuit diagrams, symbols in the EDA software being used, properties of components and connections in the circuit diagram, important parameters of electronic standard components, circuit function and testability, test points, - Layout design, PCB layout (single-sided, double-sided, multilayer), component positioning, circuit routing, spacing and minimum dimensions, EMC aspects, - Creating schematic symbols and PCB components, data sheet research, tolerances, minimum dimensions - Manufacturing aspects, post-processing, reflow and wave soldering, solder pastes, properties, fluxes, activator, solder quality, storage, soldering process, adhesive bonding, panel size and separation, assembly methods, testing and inspection - Implementing a small project

[*updated 08.01.2020*]

Recommended or required reading:
Beuth, Klaus: Elektronik: Band 2: Bauelemente, Vogel, (latest edition) Heinemann, Robert: PSPICE, Hanser, (latest edition) Huschka, Manfred: Einführung in die Multilayer-Preßtechnik, Leuze, 1988, ISBN 3-87480-038-5 Krups, Robert: SMT-Handbuch, Vogel, 1991 Leibner, Peter: Rechnergestützter Schaltungsentwurf, Krehl, Münster, 1996, 1. Aufl. Nolde, Ralf: SMD-Technik, Franzis, 1994 Paul, Reinhold: Einführung in die Mikroelektronik, Hüthig, 1985 Reichl, Herbert: Hybridintegration, Hüthig Strauss, Rudolf: SMD Oberflächenmontierte Bauteile, VTT, 1989 Tietze, Ulrich; Schenk, Christoph: Halbleiterschaltungstechnik, Springer, (latest edition)

[*updated 08.01.2020*]

Control Engineering and its Applications

Module name (EN): Control Engineering and its Applications
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2604
Hours per semester week / Teaching method: 2V+1U (3 hours per week)
ECTS credits: 4
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Oral examination
Curricular relevance: E2604 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 45 class hours (= 33.75 clock hours) over a 15-week period. The total student study time is 120 hours (equivalent to 4 ECTS credits). There are therefore 86.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Benedikt Faupel
Lecturer: Prof. Dr. Benedikt Faupel [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to describe and apply concepts, methods and applications from the field of digital signals and signal processing to control engineering tasks. They will be able to transfer mathematical correlations of continuous systems to digital systems and adapt corresponding design methods with established setting rules. Students will be able to create and optimize models and simulations of digital control loop systems with simulation tools. [*updated 08.01.2020*]

Module content:
1. Introduction and motivation 2. Fundamentals of digital signals and systems: sampling / quantization / discrete convolution / sequences and series / difference equation / analog value processing in PLC systems 3. Introduction to Z-transform / calculation rules / working with correspondence tables / transfer systems / signal-flow diagram 4. Digitization of control loop structures (digital PID algorithm, controlled systems) 5. Designing digital controllers 6. Setting rules for digital controllers 7. Designing dead-beat controllers 8. A comparison of analog and digital control systems 9. Simulation of digital control loops in Matlab and Simulink

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, lab equipment, control engineering/process automation lab

[*updated 08.01.2020*]

Recommended or required reading:
Braun, Anton: Digitale Regelungstechnik, Oldenbourg, 1997, ISBN 978-3-486-24027-6 Isermann, Rolf: Digitale Regelsysteme: Band 1: Grundlagen, deterministische Regelungen, Springer Vieweg, (latest edition) Lunze, Jan: Regelungstechnik 2: Mehrgrößensysteme, Digitale Regelung, Springer Vieweg, (latest edition)

[*updated 08.01.2020*]

Decentralized Electric Power Systems and Energy Storage Facilities

Module name (EN): Decentralized Electric Power Systems and Energy Storage Facilities

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2608

Hours per semester week / Teaching method: 4V+2P (6 hours per week)

ECTS credits: 7

Semester: 6

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work, practical exam with composition (2 lab experiments, ungraded)

Curricular relevance:
EE1609 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
E2608 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course

Workload:
90 class hours (= 67.5 clock hours) over a 15-week period.
The total student study time is 210 hours (equivalent to 7 ECTS credits).
There are therefore 142.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Michael Igel

Lecturer: Prof. Dr. Michael Igel

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be familiar with the normative and technical rules and regulations that apply in Germany for the grid connection of decentralized power generation plants (DEA) and be able to apply them. In addition, they will be familiar with the essential technical components involved in the structure and operation of decentralized power generation plants. Students will be able to use network calculation programs to calculate both the physical processes in electrical networks, taking DEA into account, and simulate the power electronic components of DEA with the aid of a simulation program. They will have basic knowledge about electrochemical energy storage facilities and can dimension these.

[*updated 08.01.2020*]

Module content:
1. Normative and technical rules and regulations 2 Power generation with decentralized power generation plants - Wind and photovoltaic plants - Calculating the grid voltage at the grid connection point - Displacement factor at the grid connection point - Grid converters as regulated power sources 3 Grid connection conditions for decentralized power generation plants - Voltage and frequency stability - Behavior during normal operation (provision of reactive power) - Behavior in the event of a fault (LVRT) 4 Energy storage facilities - Electrochemical energy storage facilities - Battery management systems - Grid connection of electrochemical energy storage facilities 5 Simulation of decentralized generation plants - SIMPLORER: power electronic components - MathLab/Simulink: systems and their control - ATPDesigner/ATP: extended load flow calculation in power grids with DEA

[*updated 08.01.2020*]

Recommended or required reading:
Andrea, Davide: Battery management systems for large lithium-ion battery packs, Artech House, 2010, ISBN 978-1-60807-104-3 Happoldt, Hans; Oeding, Dietrich: Elektrische Kraftwerke und Netze, Springer, 1978

[*updated 08.01.2020*]

Design in Electrical Engineering

Module name (EN): Design in Electrical Engineering

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2205

Hours per semester week / Teaching method: 2V+2PA (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
E2205 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 2, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Studienleitung

Lecturer: Studienleitung

[*updated 10.09.2018*]

Learning outcomes:
In this module, students will learn to evaluate the design phase of the development of an electrotechnical product, taking into account the mechanical and electrical regulations. After successfully completing this course, students will be able to read technical drawings. - They will be able to design and display simple mechanical constructions with corresponding elements using 3D-CAD tools. - They will be able to estimate which joining techniques are suitable depending on the material and application. - Students will be able to read electrical circuit diagrams and be familiar with the most important professional standards in the field of electrical installation. - They will have designed a partial aspect of a more complex product in their own project at the system integration level and documented it by means of technical drawings and/or electrical circuit diagrams.

[*updated 08.01.2020*]

Module content:
1 The standardized presentation of technical products 1.1 Basics of technical drawing: parallel projection, views, sections, dimensioning, component and assembly drawings. 1.2 Tolerances and fits, fit systems, fit selection 2 Elements of technical systems 2.1 Constructing enclosures in plate, shell and frame designs 2.2 Joining techniques and elements: welding, soldering, gluing, screws, rivets, pins 2.3 Material science 2.4 Materials used in electrical engineering 3 Creating and reading simple electrical circuit diagrams and circuit diagrams 4 Technical regulations for electrical installation and the assembly of electrical systems 5 Designing and testing simple electronic circuits 6 Standards and technical guidelines for the construction of electrical systems

[*updated 08.01.2020*]

Teaching methods/Media:
Blackboard, projector, lecture notes, 3D-CAD tools (like Autodesk Inventor), laboratory work, 3D printer, electrical circuit design

[*updated 08.01.2020*]

Recommended or required reading:
DIN e.V.; ZVEH: Elektrotechniker-Handwerk: DIN-Normen und technische Regeln für die Elektroinstallation (Normen-Handbuch), Beuth, (latest edition) Fischer, Hans: Werkstoffe in der Elektrotechnik, Hanser, (latest edition) Hoischen, Hans: Technisches Zeichnen, Cornelsen, Berlin, (latest edition) Krause, W.: Grundlagen der Konstruktion, Hanser, München, 2008 Wöstenkühler, Gerd: Grundlagen der Digitaltechnik: elementare Komponenten, Funktionen und Steuerungen, Hanser, (latest edition) Zickert, Gerald: Elektrokonstruktion: Gestaltung, Schaltpläne und Engineering mit EPLAN, Hanser, 2015, ISBN 978-3446443624

[*updated 08.01.2020*]

Designing Digital Transmission Systems

Module name (EN): Designing Digital Transmission Systems
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2609
Hours per semester week / Teaching method: 2V+1P (3 hours per week)
ECTS credits: 4
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Oral examination (50%), project work (50%)
Curricular relevance: E2609 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 45 class hours (= 33.75 clock hours) over a 15-week period. The total student study time is 120 hours (equivalent to 4 ECTS credits). There are therefore 86.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martin Buchholz
Lecturer: Prof. Dr. Martin Buchholz [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have the basic knowledge necessary for understanding digital transmission systems. - They will be able to analyze the quality of digital transmission systems using eye diagrams and bit error rates. - Students will be able to simulate a complete transmitting and receiving system with Matlab/Simulink and other EDA tools. - They will be able to implement the required digital algorithms for carrier and clock recovery, automatic gain control, filtering, pulse shaping, equalization, as well as IQ modulation and demodulation. - They will be able to specify selection criteria for an appropriate receiver architecture and modulation procedure. - Students will be able to estimate the effort required for multi-rate signal processing (decimation and interpolation). [*updated 08.01.2020*]

Module content:
1. Introduction 2. Digital baseband transmission - basics, line coding, pulse shape filtering, eye diagram, bit error rate, M-ary PAM 3. Communication channels - AWGN channel, wired channels, wireless channels, mobile channels 4. Digital bandpass transmission - IQ modulation, complex baseband representation (equivalent low-pass signals), constellation diagram, higher-order modulation methods 5. Receiver architectures - analog front end heterodyne receiver, homodyne receiver, Low IF receiver, direct-conversion receiver, up down receiver, direct sampling receiver 6. Demodulation - digital front end coherent and non-coherent detection, matched filtering, channel selection, mirror frequency suppression, clock and carrier synchronization, AGC, equalizer 7. Multirate signal processing - interpolation, decimation 8. Wideband transmission techniques - spread spectrum, CDMA, OFDM, UWB 9. Simulation of telecommunication systems in Matlab and Simulink

[*updated 08.01.2020*]

Teaching methods/Media:
Projector, lecture notes, Matlab, EDA tools, IQ lab (laboratory test environment)

[*updated 08.01.2020*]

Recommended or required reading:
Haykin, Simon: Digital Communications, John Wiley & Sons Hoffmann, Josef; Quint, Franz: Signalverarbeitung mit Matlab und Simulink: Anwendungsorientierte Simulationen, Oldenbourg, 2007 Oppenheim, Alan V.; Schafer, Ronald W.; Buck, John R.: Zeitdiskrete Signalverarbeitung, Oldenbourg, (latest edition) Proakis, John G., Salehi, Masoud: Grundlagen der Kommunikationstechnik, Pearson, 2004, 2. Aufl. Proakis, John G.: Digital Communications, (latest edition) Roppel, Carsten: Grundlagen der digitalen Kommunikationstechnik, Hanser, 2006 van Trees, Harry L.: Detection, Estimation and Modulation, John Wiley

[*updated 08.01.2020*]

Digital Electronics

Module name (EN): Digital Electronics
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2105
Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical examination with report (not graded)
Curricular relevance: E2105 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 1, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: E2610 Integration-Compatible Circuitry [*updated 18.07.2019*]
Module coordinator: Prof. Dr. Albrecht Kunz
Lecturer: Prof. Dr. Albrecht Kunz [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this module, students will be able to design and implement digital systems (switching networks and switchgear) independently. They will have mastered methods from two-element Boolean algebra for describing and simplifying switching functions. Students will be able to perform calculations in the binary numeral system in elementary arithmetics and convert numbers from one number system to another (binary, octal, hexadecimal). They will be able to use graphical methods (Karnaugh map) and computational methods (Quine-McCluskey algorithm) to simplify circuits and clearly draw the resulting circuits. Students will be familiar with the properties and applications of different codes (e.g. BCD, Aiken, Gray, ASCII). They will understand the structure and function of flip-flops for realizing digital electronic components (e.g. counters, code converters, shift registers). Students will be familiar with digital arithmetic circuits, data selectors, multiplexer and demultiplexer circuits. These are important for understanding CPU architectures in subsequent lectures (e.g. microcontrollers, embedded systems). They will be familiar with the basics of automata theory and be able to design simple automata. In the practical part of the course, students will independently build digital circuits in small groups or simulate digital circuits and verify their functionality. By conducting experiments together, they will learn cooperative behavior.

[*updated 08.01.2020*]

Module content:
1. Introduction and the fundamentals of digital electronics 2. Mathematical basics: Boolean function, Boolean algebra, number systems (decimal, binary, octal, hexadecimal) addition, subtraction, multiplication, division of binary numbers 3. Coding methods: purpose of coding, representation of different codes 4. Representation, synthesis and analysis of Boolean functions: disjunctive and conjunctive normal form, graphical circuit synthesis (Karnaugh map), minimization method according to Quine-McCluskey 5. Optimization of switching networks: logic gates in digital electronics, linking several gates, substitution by NOR / NAND gates 6. Circuit design based on the 2 out of 3 circuit 7. Flip-flops: structure and operation of flip-flops, pulse-triggered and edge-triggered flip-flops, characteristic equation 8. Registers and memory circuits: designing asynchronous and synchronous counters 9. Arithmetic circuitry: half adder, full adder, carry-lookahead adder, subtractors, multipliers 10. Digital selection and connection circuitry: multiplexer, demultiplexer, comparators, A/D and D/A converters 11. Automata theory: Moore and Mealy machines, state diagram, state transition table, program flowchart

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, presentation with beamer during the lecture and tutorial, use of lab equipment (signal generator, oscilloscope, digital multifunction measuring instruments, single board computer) during lab class

[*updated 08.01.2020*]

Recommended or required reading:
Becker, Jürgen; Lipp, Hans-Martin: Grundlagen der Digitaltechnik, De Gruyter Oldenbourg, 2010, 7. Aufl., ISBN 978-3486597479 Beuth, Klaus: Digitaltechnik (XXXX), Vogel, (latest edition) Fricke, Klaus: Digitaltechnik - Lehr- und Übungsbuch für Elektrotechniker und Informatiker, Vieweg + Teubner Meuth, Hermann: Digitaltechnik: Eine anschauliche und moderne Einführung, VDE, 2017, ISBN 978-3800736379 Tietze, Ulrich; Schenk, Christoph: Halbleiterschaltungstechnik, Springer, (latest edition) Woitowitz, Roland; Urbanski, Klaus; Gehrke, Winfried: Digitaltechnik: Ein Lehr- und Übungsbuch, Springer, (latest edition)

[*updated 08.01.2020*]

Digital Signal Processing

Module name (EN): Digital Signal Processing

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2510

Hours per semester week / Teaching method: 2V+2P (4 hours per week)

ECTS credits: 5

Semester: 5

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2510 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer: Prof. Dr. Martin Buchholz

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this module, students will be able to carry out digital signal processing and analyze telecommunications signals and systems. They will be familiar with the different structures of discrete time systems and be able to analyze them analytically with the help of the discrete Fourier transform and the Z-transform. They will be capable of specifying and implementing digital, recursive and non-recursive filters based on a defined filter specification. Students will be able to use development tools that simulate algorithms and implement them in an FPGA using a model-based approach. They will be able to describe the design flow for the real-time realization of digital algorithms. Student will independently implement digital filters, signal generators and other digital algorithms in the course of this module.

[*updated 08.01.2020*]

Module content:
1. Introduction, motivation 2. Basics 3. Ideal and real sampling, sampling theorem, practical aspects of sampling 4. Discrete-time signals and systems 5. Discrete time convolution, FIR and IIR systems 6. Structure of discrete time systems 7. Representation of discrete time signals and systems in the frequency domain 8. The Z-transform 9. Designing recursive digital filters 10. Design of non-recursive digital filters 11. Simulating digital signal processing systems 12. Model-based implementation of digital algorithms in an FPGA Tutorials will be available for each chapter. Parallel to the theoretical part, digital algorithms will be simulated in the PC lab using a suitable software tool and prepared for implementation in an FPGA (Field Programable Gate Array) or DSP (Digital Signal Processor).

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, beamer, PC lab, EDA simulation tools with classroom licenses

[*updated 08.01.2020*]

Recommended or required reading:
Brigham, Elbert Oran: FFT Anwendungen, Oldenbourg, 1997 Götz, Hermann: Einführung in die digitale Signalverarbeitung, Teubner, 1998, 3. Aufl. Hoffmann, Josef; Quint, Franz: Signalverarbeitung mit Matlab und Simulink: Anwendungsorientierte Simulationen, Oldenbourg, 2007 Kammeyer, Karl-Dirk; Kroschel, Kristian: Digitale Signalverarbeitung Filterung und Spektralanalyse mit MATLAB-Übungen, Springer Vieweg, (latest edition) Oppenheim, Alan V.; Schafer, Ronald W.; Buck, John R.: Zeitdiskrete Signalverarbeitung, Oldenbourg, (latest edition) Schmidt, Herrad; Schwabl-Schmidt, Manfred: Digitale Filter: Theorie und Praxis mit AVR-Mikrocontrollern, Springer Vieweg, 2014, ISBN 978-3658035228 Stearns, Samuel D.; Hush Don R.: Digitale Verarbeitung analoger Signale, Oldenbourg, 1999, 7. Aufl. von Grünigen, Daniel Ch.: Digitale Signalverarbeitung, Hanser, (latest edition) Werner, Martin: Digitale Signalverarbeitung mit Matlab, Intensivkurs mit 16 Versuchen, Vieweg + Teubner, (latest edition)

[*updated 08.01.2020*]

Electric Power Supply Systems 1

Module name (EN): Electric Power Supply Systems 1
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2506
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 5
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical exam with composition (2 lab experiments, ungraded)
Curricular relevance: EE1504 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 5, mandatory course E2506 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Michael Igel
Lecturer: Prof. Dr. Michael Igel [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to apply modal transformations to calculate symmetric and asymmetric network states in forward and backward transformations. They will be able to calculate voltages and currents in the symmetrical and asymmetrical normal and short-circuit operation of electrical power supply networks with the aid of symmetrical components. Students will be able to create the equivalent circuit diagram of an electrical power supply network in symmetric components and calculate short-circuit currents and node voltages. They will be able to select equivalent circuits for equipment on a case-by-case basis and parameterize them with nameplate data. They will able to calculate wire nameplate data from the wires´ geometrical and electrical parameters. Students will be able to analyze the design and structure of switchgear and assess the significance and functionality of the components used in it. [*updated 08.01.2020*]

Module content:
1. Modal transformations: diagonal transformations, symmetric components, 012- and hab-system, physical interpretation 2. Power lines: Structure, transmission tower shapes, overhead line cables, mean geometric distance, ground wire reduction factor, inductors and capacities (symmetrical components), homogeneous transmission line, characteristic impedance and natural power, equivalent circuit diagrams 3. Transformers: Three-winding transformer, zero phase-sequence system 4. Asymmetrical mains operation: Symmetrical and asymmetrical errors, application of symmetrical components, transverse errors, longitudinal errors 5. Switches and switchgear: switch types, switch requirements, switching off in three-phase systems, construction and structure of switchgear, switching in switchgear, current and voltage transformers

[*updated 08.01.2020*]

Teaching methods/Media:
Lectures note as a PDF, projector, program for calculating electrical energy supply networks

[*updated 08.01.2020*]

Recommended or required reading:
Flosdorff, René; Hilgarth, Günther: Elektrische Energieverteilung, Teubner, (latest edition) Happoldt, Hans; Oeding, Dietrich: Elektrische Kraftwerke und Netze, Springer, 1978 Heuck, Klaus; Dettmann, Klaus-Dieter: Elektrische Energieversorgung, Springer Vieweg, (latest edition) Schlabbach, Jürgen: Elektroenergieversorgung, VDE, 2003, 2. Aufl.

[*updated 08.01.2020*]

Electric Power Supply Systems 2

Module name (EN): Electric Power Supply Systems 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2606
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 4
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Written exam (50%), practical exam with composition (2 lab experiments, 50%)
Curricular relevance: EE1603 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 6, mandatory course E2606 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 120 hours (equivalent to 4 ECTS credits). There are therefore 75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Michael Igel
Lecturer: Prof. Dr. Michael Igel [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to recognize the different types of star connections in electric power supply networks, evaluate the advantages and disadvantages of each and select the ideal solution on a case-to-case basis. They will be able to calculate the required equipment. Using the complex alternating current calculation and a network calculation program, they will be able to calculate voltages and currents in normal operation and assess their reliability using the applicable standards and application guidelines. Students will be able to draw up an equivalent circuit diagram of an electrical power supply network in short-circuit operation and calculate short-circuit currents and short-circuit voltages. They will be able to assess the dimensioning of the equipment used in the network. Students will be able to carry out short-circuit current calculations according to the standard or the superposition method. They will be able to compare their calculation results with those of a grid calculation program. They will be able to validate the results of the network calculation program with reference networks.

[*updated 08.01.2020*]

Module content:
1. Star connections: networks with isolated or compensated neutral point, networks with semi-rigid or rigid neutral point earthing, equivalent circuits, calculating with the aid of symmetrical components, compensation coil, degree of detuning, zero-sequence voltage 2. Operating behavior of generators: equivalent circuit diagram, steady state behavior (no-load and short-circuit operation) 3. Calculating dynamic network processes: applying symmetrical components, numerical models of equipment, short-circuit current calculation according to IEC60909, initial short-circuit alternating current, maximum aperiodic short-circuit current, breaking capacity, sustained short-circuit current, equivalent short-circuit current

[*updated 08.01.2020*]

Teaching methods/Media:
Lectures note as a PDF, projector, program for calculating electrical energy supply networks

[*updated 08.01.2020*]

Recommended or required reading:
Flosdorff, René; Hilgarth, Günther: Elektrische Energieverteilung, Teubner, (latest edition) Happoldt, Hans; Oeding, Dietrich: Elektrische Kraftwerke und Netze, Springer, 1978 Heuck, Klaus; Dettmann, Klaus-Dieter: Elektrische Energieversorgung, Springer Vieweg, (latest edition) Schlabbach, Jürgen: Elektroenergieversorgung, VDE, 2003, 2. Aufl.

[*updated 08.01.2020*]

Electrical Engineering Theory 1

Module name (EN): Electrical Engineering Theory 1

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2304

Hours per semester week / Teaching method: 2V+1U (3 hours per week)

ECTS credits: 5

Semester: 3

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2304 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course

Workload:
45 class hours (= 33.75 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 116.25 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Dietmar Brück

Lecturer: Prof. Dr.-Ing. Dietmar Brück

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to demonstrate Maxwell´s equations and describe the application areas. They will be able to independently derive the boundary and transition conditions and completely decouple Maxwell´s equations using the example of the co-axial cable and finally solve and interpret the telegrapher´s equations. Furthermore, they will understand and be able to apply and evaluate two-port networks Students will also be able to determine switch-on and switch-off processes.

[*updated 08.01.2020*]

Module content:
1. Maxwell´s theory and co-axial cables 2. Two-port network theory 3. Circuit forms, open circuit and short circuit 4. Chain matrix, resistor matrix, conductance matrix, 5. Ladder network, parallel connection, series connection, recurrent two pole

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Baumeister, Johann: Stable Solution of Inverse Problems, Vieweg, Braunschweig, 1987 Becker, Klaus-Dieter: Theoretische Elektrotechnik, VDE, Berlin, 1982, ISBN 3-80071275-X Bergmann, Ludwig; Schaefer, Clemens: Lehrbuch der Experimentalphysik, Bd. III Teil 1: "Wellenoptik", Walter de Gruyter, Berlin, 1962 Blume, Siegfried: Theorie elektromagnetischer Felder, Hüthig, Heidelberg, 1991, 3. Aufl. Collin, Robert E,: Field theory of guided waves, McGraw-Hill, New York, 1960 Hafner, Christian: Numerische Berechnung elektromagnetischer Felder, Springer, Berlin, 1987, ISBN 3-540-17334-X Hofmann, Hellmut: Das elektromagnetische Feld: Theorie u. grundlegende Anwendungen, Springer, Wien, (latest edition) Jänich, Klaus: Analysis für Physiker und Ingenieure, Springer, Berlin Schäfke, Friedrich Wilhelm: Einführung in die Theorie der speziellen Funktionen der mathematischen Physik, Springer, Berlin, 1963 Simonyi, Károly: Theoretische Elektrotechnik, VEB Deutscher Verlag der Wissenschaften, Berlin, 1977

[*updated 08.01.2020*]

Electrical Machines 1

Module name (EN): Electrical Machines 1

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2507

Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)

ECTS credits: 4

Semester: 5

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam, practical exam with composition (2 lab experiments, ungraded)

Curricular relevance:
E2507 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 120 hours (equivalent to 4 ECTS credits).
There are therefore 75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Stefan Winternheimer

Lecturer: Prof. Dr.-Ing. Stefan Winternheimer

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be familiar with the basics of electromechanical energy conversion, in particular how to apply the basic laws of electrical engineering to solving problems in electrical machines. In addition, they will be able to use the acquired knowledge to determine the most important electromagnetic quantities in electrical machines. The course provides a basis for understanding the spatial and temporal relationships in electrical machines and will enable students to draw parallels between the properties of different machine types. The methods learned in this course also form the basis for entry into the advanced BA and MA "Electrical Machines" modules.

[*updated 08.01.2020*]

Module content:
1. Introduction 1.1 Applying Maxwell´s equations to the electrical machine 1.2 Magnetic circuit of an electric machine 1.3 Conductor parameters of an electrical machine 2 Windings, currents and air-gap flow2.1 Basic terms 2.2 Linear current density, electric loading 2.3 Magnetizing a coil and a winding 2.4 Winding factor 2.5 Matrix representation of winding magnetomotive forces (MMF) 2.6 Time-dependent excitation 2.7 Generating a rotating magnetic field 2.8 Representation of the air gap flow in a rotating reference frame 2.9 Commutator windings 2.10 Squirrel cage rotor winding 3 Air gap flow and induction 3.1 DQ representation of spatial dimensions in air gap induction 3.2 Influence of slots on air-gap flow and induction; Carter factor 3.3 Resultant air gap flow and air gap induction in a commutator machine 3.4 Resultant air gap flow and air gap induction in a synchronous machine 3.5 Resultant air gap flow and air gap induction in an asynchronous machine 4. Equivalent circuits electrical machines 4.1 Main and stray inductances 4.2 Main inductance of a coil and winding in a slotless cylindrical unsaturated machine 4.3 Main inductance of a coil and winding in a slotless cylindrical saturated machine 4.4 Main inductance of coil and winding in unsaturated machine with variable air gap geometry 4.5 Mutual inductance between windings in a slotless unsaturated machine 4.6 Influence of slotting on both sides of the air gap on main and mutual inductances 4.7 Equivalent circuit diagram of electrical machines 4.8 Induced voltage in windings of electrical machines 5. Force and torque in electrical machines 5.1 The role of magnetic energy in electromechanical energy conversion 5.2 The force on conductors in slots of electrical machines 5.3 The torque generated by currents per winding and the torque function 5.4 Electromagnetic torque as a function of air gap sizes

[*updated 08.01.2020*]

Teaching methods/Media:
Transparencies, blackboard, lecture notes and electronic handouts

[*updated 08.01.2020*]

Recommended or required reading:
Eckhardt, Hanskarl: Grundzüge der elektrischen Maschinen, Teubner, 1982 Richter, Rudolf: Elektrische Maschinen, Band 1: Allgemeine Berechnungselemente, Birkhäuser, 1951

[*updated 08.01.2020*]

Electrical Machines 2

Module name (EN): Electrical Machines 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2607
Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)
ECTS credits: 4
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical exam with composition (2 lab experiments, ungraded)
Curricular relevance: E2607 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 120 hours (equivalent to 4 ECTS credits). There are therefore 75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Stefan Winternheimer
Lecturer: Prof. Dr.-Ing. Stefan Winternheimer [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to analyze an electrical machine as a drive or power supply network component and use parameters of its equivalent circuit to calculate operating characteristics. They will know the morphological differences between different machine types and their influence on machine behavior in stationary condition. Students will be able to relate the general equation for torque as a derivative of the magnetic energy stored in the air gap to the equations of torque-speed or torque-angle curves of conventional machine types. They will thus, be able to successfully handle complex topics from the field of electrical machines and drives and be able to apply the required analysis tools later in their career or during the Master´s program. [*updated 08.01.2020*]

Module content:
1. Induction machine in steady state 1.1 Construction and operating principle of induction machines 1.2 Effects of the fundamental wave of the air-gap flux density on induction machines 1.3 Effects of the harmonic waves of the air-gap flux density on induction machines 1.4 Self-excited induction machine 1.5 Single-phase machine 1.6 Capacitor braking 1.7 Speed control in induction machines 2 Commutator machine in steady state 2.1 Operating behavior of a direct current machine 2.2 Induced voltage and electromagnetic moment 2.3 Armature reaction 2.4 Commutation 2.5 Direct current generators 2.6 Direct current motors 2.7 AC commutator machines 2.8 Speed control in commutator machines 3 Synchronous machine in steady state 3.1 Design features of synchronous machines 3.2 Armature reaction and synchronous reactance 3.3 Operating characteristics of cylindrical-rotor synchronous machines on a rigid grid 3.4 Salient pole machines 3.5 Permanent magnet excited synchronous machines

[*updated 08.01.2020*]

Teaching methods/Media:
Transparencies, blackboard, lecture notes and electronic handouts

[*updated 08.01.2020*]

Recommended or required reading:
Eckhardt, Hanskarl: Grundzüge der elektrischen Maschinen, Teubner, 1982 Richter, Rudolf: Elektrische Maschinen, Band 1: Allgemeine Berechnungselemente, Birkhäuser, 1951

[*updated 08.01.2020*]

Electronics 1

Module name (EN): Electronics 1
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2303
Hours per semester week / Teaching method: 3V+2U (5 hours per week)
ECTS credits: 5
Semester: 3
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2303 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course
Workload: 75 class hours (= 56.25 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 93.75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: E2408 CAD in Microelectronics E2610 Integration-Compatible Circuitry [*updated 18.07.2019*]
Module coordinator: Prof. Dr. Volker Schmitt
Lecturer: Prof. Dr. Volker Schmitt [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to describe the functions of the electronic components presented in the course, list typical applications and explain different parameters. They will be able to analyze and dimension electronic circuits using computational and graphical methods. Students will understand relevant circuits functionally and be able to convert simple functions into suitable circuits while taking restrictive boundary conditions into account. Students will be able to calculate the operating points of diodes and bipolar junction transistors in amplifier circuits and their small-signal transmission properties.

[*updated 08.01.2020*]

Module content:
- Basic terms, overview - Diodes: characteristic, operating point, rectifier, peak current, ripple, smoothing, voltage multiplier, amplitude limiter, sampling gate, voltage stabilization, envelope detector - Linear diode model (piece by piece), small-signal analysis, small-signal equivalent circuit - Thermal characteristics, junction and diffusion capacitance, breakdown mechanisms - Special diodes: PIN diodes, Zener diode, backward diode, tunnel diode, varicap diode, Schottky diode, photo diode, solar cell, light emitting diode, laser diode - Brief introduction to circuit simulation using PSPICE - Bipolar transistors: Design, characteristic curves, Ebers-Moll model, operating areas, static and dynamic properties, thermal characteristics, limit data - Circuit variants for operating point adjustment, stabilization - Representing parameters: H- and Y-parameters, operating variables, H-parameters and characteristics field, Y-parameter and basic circuits of the bipolar transistor - Small-signal amplifier with bipolar transistors, small-signal models, Giacoletto model, characteristic cutoff frequencies, AF behavior, RF behavior, negative feedback - Power amplifier with bipolar transistors: A, B and AB operation, efficiency, power dissipation

[*updated 08.01.2020*]

Teaching methods/Media:
Transparencies, templates and exercise sheets in electronic form

[*updated 08.01.2020*]

Recommended or required reading:
Bystron, Klaus; Borgmeyer, Johannes: Grundlagen der Technischen Elektronik, Fachbuchverlag Leipzig, 1990, 2. Aufl. Cooke, Mike J.: Halbleiter-Bauelemente, Hanser, 1993, ISBN 3-446-16316-6 Giacoletto L.J.: Electronics Designer"s Handbook, McGraw-Hill, 1977 Koß, Günther; Reinhold, Wolfgang; Hoppe, Friedrich: Lehr- und Übungsbuch Elektronik, Hanser, (latest edition) Millman, Jacob; Grabel, Arvin: Microelectronics, McGraw-Hill, 1987, 2nd Ed., ISBN 0-07-100596-X Möschwitzer, Albrecht: Grundlagen der Halbleiter- & Mikroelektronik, Band 1: Elektronische Halbleiterbauelemente, Hanser, 1992 Müller, Rudolf: Grundlagen der Halbleiter-Elektronik, Springer, 1995, 7. Aufl. Reisch, Michael: Elektronische Bauelemente: Funktion, Grundschaltungen, Modellierung mit SPICE, Springer, (latest edition) Tietze, Ulrich; Schenk, Christoph: Halbleiterschaltungstechnik, Springer, (latest edition)

[*updated 08.01.2020*]

Electronics 2

Module name (EN): Electronics 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2401
Hours per semester week / Teaching method: 3V+1U+2P (6 hours per week)
ECTS credits: 7
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Written exam (67%), practical exam with composition (6 lab experiments, 33%)
Curricular relevance: E2401 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 90 class hours (= 67.5 clock hours) over a 15-week period. The total student study time is 210 hours (equivalent to 7 ECTS credits). There are therefore 142.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: E2610 Integration-Compatible Circuitry [*updated 18.07.2019*]
Module coordinator: Prof. Dr. Volker Schmitt
Lecturer: Prof. Dr. Volker Schmitt [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to explain the difference between an ideal and a real operational amplifier and list application areas and applications. They will be able to calculate frequency responses and transfer characteristics of operational amplifier circuits. Students will be able to design circuits with operational amplifiers that can perform specific predefined functions. They will understand the functional principle of field effect transistors, be able to distinguish basic types from one another and name and explain typical parameters and applications. The computational and graphical methods for circuit analysis and dimensioning already discussed in the Electronics 1 lecture will also be applied by students to circuits with field effect transistors and operational amplifiers. Students will be able to make meaningful decisions with regard to technology for specific use cases. Students will work together in small groups during the lab class. They will be working with the typical measuring equipment found in electronics laboratories and become more and more familiar with how the equipment operates. Students will evaluate the results obtained during their experiments according to various criteria and present their results in a suitable format and in written form in their composition.

[*updated 08.01.2020*]

Module content:
- Operational amplifiers as components: terms and definitions, ideal and real op-amps, non-inverting and inverting amplifiers, differential amplifier, active filters, in-phase regulator, logarithmic amplifier, exponential amplifier, comparator, Schmitt trigger, astable multivibrator, monostable multivibrator, gain-bandwidth product, stability and compensation, - Field-effect transistors: junction-gate field-effect transistors, insulated-gate field-effect transistors, n-channel and p-channel, structure, function, characteristics, properties, temperature behavior, FET tetrode, small signal models, - Circuits with field effect transistors: biasing, voltage-controlled resistor, small signal amplifier, MOSFET inverter, NMOS gate, CMOS gate, - Logic circuits with diodes and bipolar transistors: static switching behavior and dynamic switching behavior of diode and bipolar transistor, diode-transistor logic (DTL), transistor-transistor logic (TTL), multiple-emitter transistor, - Circuit principles in operational amplifiers, differential amplifiers, small signal behavior, transfer characteristic, operating points, current source circuits, level shifter, output stage, - ECL gates: inverters, NOR, OR gate, NAND, AND gate, - Oscillators: selection criteria, frequency stability, RC, LC, quartz, oscillation condition, open-loop gain, parametric equation, circuits, - Structure and production of Si planar transistors: masks, lithography, etching, doping Lab experiments: semiconductor diodes, semiconductor characteristics, transistor ground circuits, transistor switching behavior, as well as TTL and CMOS technology, operational amplifiers,

[*updated 08.01.2020*]

Teaching methods/Media:
Overhead slides, templates and exercise sheets in electronic form, lab instructions

[*updated 08.01.2020*]

Recommended or required reading:
Bystron, Klaus; Borgmeyer, Johannes: Grundlagen der Technischen Elektronik, Fachbuchverlag Leipzig, 1990, 2. Aufl. Cooke, Mike J.: Halbleiter-Bauelemente, Hanser, 1993, ISBN 3-446-16316-6 Giacoletto L.J.: Electronics Designer"s Handbook, McGraw-Hill, 1977 Koß, Günther; Reinhold, Wolfgang; Hoppe, Friedrich: Lehr- und Übungsbuch Elektronik, Hanser, (latest edition) Millman, Jacob; Grabel, Arvin: Microelectronics, McGraw-Hill, 1987, 2nd Ed., ISBN 0-07-100596-X Möschwitzer, Albrecht: Grundlagen der Halbleiter- & Mikroelektronik, Band 1: Elektronische Halbleiterbauelemente, Hanser, 1992 Müller, Rudolf: Grundlagen der Halbleiter-Elektronik, Springer, 1995, 7. Aufl. Reisch, Michael: Elektronische Bauelemente: Funktion, Grundschaltungen, Modellierung mit SPICE, Springer, (latest edition) Tietze, Ulrich; Schenk, Christoph: Halbleiterschaltungstechnik, Springer, (latest edition)

[*updated 08.01.2020*]

Engineering Mathematics 1

Module name (EN): Engineering Mathematics 1
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2101
Hours per semester week / Teaching method: 5V+2U (7 hours per week)
ECTS credits: 8
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2101 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 1, mandatory course
Workload: 105 class hours (= 78.75 clock hours) over a 15-week period. The total student study time is 240 hours (equivalent to 8 ECTS credits). There are therefore 161.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: E2204 Fundamentals of Electrical Engineering 2 [*updated 05.10.2019*]
Module coordinator: Prof. Dr. Gerald Kroisandt
Lecturer: Dr. Stephan Schaeidt [*updated 12.05.2020*]
Learning outcomes: After successfully completing this course, students will be able to apply elementary, mathematical computing techniques to mathematical problems and solve sample tasks. [*updated 08.01.2020*]

Module content:
Principles of analysis and algebra, Sets, Set of real numbers, Inequations, Mathematical induction, Binomial theorem, Functions, Special functions, Basic terms and general properties, Sequences and limits, Limits and continuity of functions, Polynomial functions, Fractional rational functions, Power functions,Algebraic functions, Trigonometric functions and inverse trigonometric functions, Exponential and logarithmic functions, Hyperbolic and inverse hyperbolic functions, Linear algebra, Basic concepts of vector analysis, Vectors in a rectangular coordinate system, The dot product, The cross product, Normal vector, Multiple products of vectors, Linear systems of equations, Matrices, Addition and multiplication, Inverse determinants, Definition and properties, Rank of a linear system of equations, Gaussian elimination, Solution behavior, Cramer´s rule, Differential calculus I,The concept of derivation Basic rules of differentiation, The derivation of elementary functions, Derivation rules, Calculation of limits with L´Hospital, Integral calculus I, The indefinite integral, The definite integral, Applications of integral calculus in geometry

[*updated 08.01.2020*]

Teaching methods/Media:
Board, overhead projector, beamer, lecture notes (planned)

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Engineering Mathematics 2

Module name (EN): Engineering Mathematics 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2201
Hours per semester week / Teaching method: 5V+2U (7 hours per week)
ECTS credits: 8
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2201 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 2, mandatory course
Workload: 105 class hours (= 78.75 clock hours) over a 15-week period. The total student study time is 240 hours (equivalent to 8 ECTS credits). There are therefore 161.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Gerald Kroisandt
Lecturer: Dr. Stephan Schaeidt [*updated 12.05.2020*]
Learning outcomes: After successfully completing this module, students will be able to calculate complex numbers and complex functions and represent them on the complex plane. They will have acquired advanced knowledge of differential and integral calculus. They will be able to solve second order differential equations and thus, be able to analyze and calculate the fundamental time behavior of elementary and complex systems in different disciplines. [*updated 08.01.2020*]

Module content:
Complex numbers and functions Definition and representation The Gaussian number plane Representation forms and conversion Basic arithmetic operations Exponentiation and roots of complex numbers Differential calculus II The differential of a function Extrema and inflection points Functions with several independent variables Zero-dimensional space Functions of several variables Differential calculus Calculating extrema Gradients, divergence, rotation Integral calculus II Integration techniques Applications of integral calculus Improper integral Numerical integration Line integral, definition and examples Differential equations (DGl) Basic terms First order DEs - Geometric considerations - Separable 1st order equations - Separation of variables and variation of constants 2nd order DEs - 2nd order Linear DEs with constant coefficients - Properties of linear DEs - 2nd order homogeneous linear DEs - 2nd order inhomogeneous DEs Systems of linear DEs with constant coefficients

[*updated 08.01.2020*]

Teaching methods/Media:
OLD VERSION Blackboard, overhead projector, beamer, lecture notes (planned)

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Engineering Mathematics 3

Module name (EN): Engineering Mathematics 3
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2301
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 5
Semester: 3
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2301 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Gerald Kroisandt
Lecturer: Dr. Stephan Schaeidt [*updated 12.05.2020*]
Learning outcomes: After successfully completing this course, students will be able to use Taylor series for different qualitative and approximate estimations of different problems in electrical engineering and be able to use Fourier series to describe temporally periodic processes. They will have well-founded knowledge and the corresponding technical skills for examining electrotechnical questions with the help of the Laplace transform. Students will be able to systematically solve systems of coupled differential equations with this method and their knowledge about linear systems of equations and thus analytically study smaller systems. By understanding the eigenvalue problem, students will have basic knowledge about collective variables in mechanical and electrical systems, which also allows a deeper understanding of complex electrotechnical systems. [*updated 08.01.2020*]

Module content: Eigenvalue theory Motivation Characteristic polynomial of a matrix Calculating eigenvalues, eigenvectors and eigenspaces Eigenvalue theory of Hermitian and symmetric matrices Diagonalization, principal axis transformation Infinite series Series of constants Function series Power series Taylor series Fourier series Fourier and Laplace transforms The Fourier transform The Laplace transform Inverse transform methods Comparison of the Fourier and the Laplace transforms Applications [*updated 08.01.2020*]
Teaching methods/Media: OLD VERSION Board, overhead projector, beamer, lecture notes (planned) [*updated 08.01.2020*]
Recommended or required reading: [*still undocumented*]

Engineering Tools

Module name (EN): Engineering Tools

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2307

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 2

Semester: 3

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
E2307 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer: Prof. Dr. Martin Buchholz

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to select a suitable calculation tool for a given engineering task. - They will know how to use MATLAB and Simulink for solving mathematical problems numerically and simulating systems. - Students will be able to apply MATLAB´s vector- and matrix-based approach to given examples. - They will be able to use MATLAB and Simulink to generate, process and evaluate signals and systems. - Students will be able to process data using MATLAB and Simulink, as well as display and analyze simulation or measurement results. - They will be capable of applying their knowledge to image and audio signal processing. - Students will understand the possibilities of and methods used by LABVIEW for simulation and lab work. - They will have acquired the basic knowledge necessary for taking part in other modules where these engineering tools are applied in a more subject-specific manner.

[*updated 08.01.2020*]

Module content:
1. MATLAB´s user interface 2. Working interactively with the basic elements and functions in MATLAB 3. Programming in MATLAB: scripts and functions 4. Representing measurement results in 2D and 3D graphics 5. File operations 6. Signal processing with MATLAB 7. Image processing with MATLAB 8. Symbolic math 9. Introduction to Simulink 10. Signal processing with Simulink 11. Introduction to LABVIEW

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, smartboard, PC with MATLAB and LABVIEW classroom license

[*updated 08.01.2020*]

Recommended or required reading:
Bode, Helmut: MATLAB-SIMULINK: Analyse dynamischer Systeme, Teubner, 2006, 2. Aufl. Bosl, Angelika: Einführung in MATLAB/Simulink, Hanser, (latest edition) Georgi, Wolfgang; Metin, Ergun: Einführung in LabVIEW, Hanser, (latest edition) Grupp, Frieder: Simulink: Grundlagen und Beispiele, Oldenbourg, 2007, ISBN 978-3-486-580914 Hoffmann, Josef; Quint, Franz: Signalverarbeitung mit Matlab und Simulink: Anwendungsorientierte Simulationen, Oldenbourg, 2007 Kammeyer, Karl-Dirk; Kroschel, Kristian: Digitale Signalverarbeitung Filterung und Spektralanalyse mit MATLAB-Übungen, Springer Vieweg, (latest edition) Werner, Martin: Digitale Signalverarbeitung mit Matlab, Intensivkurs mit 16 Versuchen, Vieweg + Teubner, (latest edition)

[*updated 08.01.2020*]

Fundamentals of Electrical Engineering 2

Module name (EN): Fundamentals of Electrical Engineering 2

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2204

Hours per semester week / Teaching method: 4V+1U+1P (6 hours per week)

ECTS credits: 7

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam, tutorial (ungraded), practical exam with composition (3 lab experiments, ungraded)

Curricular relevance:
EE1204 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 2, mandatory course
E2204 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 2, mandatory course

Workload:
90 class hours (= 67.5 clock hours) over a 15-week period.
The total student study time is 210 hours (equivalent to 7 ECTS credits).
There are therefore 142.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
E2101 Engineering Mathematics 1
E2102 Physics1
E2104

[*updated 05.10.2019*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Marc Klemm

Lecturer: Prof. Dr. Marc Klemm

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will have acquired the basic electrotechnical knowledge required for all areas of specialization in the study program and be familiar with analysis methods for magnetic fields, as well as the alternating current and three-phase current theory. I.e. they will be able to carry out calculations with the respective physical formulas and quantities and derive useful solutions, as well as make calculations for tasks given in this field based on common physical-mathematical laws, in particular with the help of complex numbers. They will be familiar with the analogies between flow, electric and magnetic fields, and thus, be capable of determining the field pattern and the way it is fundamentally influenced by shapes and materials for frequently occurring geometries. They will also be able to design magnetic circuits. Students will be able to carry out computational and metrological analyses on and make layouts of AC and three-wire circuits that are new to them, as well as dimension components. Thanks to the experiments carried out in the lab class, students will have experience in teamwork, time management and working independently. The experiments are designed as small projects and carried out in small groups.

[*updated 08.01.2020*]

Module content:
1. Magnetic fields 1.1 Basic physical quantities and fundamental laws, 1.2 Field calculation; boundary layer behavior; 1.3 Properties of ferromagnetic and ferrimagnetic materials, permanent magnets; polarization processes in materials; descriptive terms and characteristics; 1.4 Magnetic circuit: equivalent circuit, shear; 1.5 Law of induction, applications; self-inductance, 1.6 Energy, forces on pole surfaces, interfaces and moving charges; 1.7 Coupled systems: transformer; RL circuit, switching operations 2. AC / three-phase AC theory 2.1 Periodic function, characteristics of a sinusoidal alternating variable, mathematical operations, 2.2 Basic two-terminal circuits R, L, C, power in time domain, 2.3 Phasor diagrams, complex number calculation, circuit calculation with transformed image function 2.4 Complex impedance, network calculation, complex impedance matching 2.5 Locus diagrams, low and high-pass filters 2.5 Balanced and unbalanced three-phase systems Lab: V4: Magnetic fields and magnetic systems; V5: Periodic quantities, FG and oscilloscope, frequency and phase response, RC circuits V6: AC and three-phase AC; measuring and calculating power, compensation

[*updated 08.01.2020*]

Teaching methods/Media:
Blackboard, presentation, lecture notes, illustrative objects

[*updated 08.01.2020*]

Recommended or required reading:
Ameling, Walter: Grundlagen der Elektrotechnik (Band 1 & 2), Vieweg, 1997 Bosse, Georg: Grundlagen der Elektrotechnik (Band 1-4), BI Clausert, Horst; Wiesemann, Gunther: Grundgebiete der Elektrotechnik (Band 1-2), Oldenbourg, (latest edition) Frohne, Heinrich: Moeller Grundlagen der Elektrotechnik, Vieweg & Teubner, (latest edition) Lunze, Klaus; Wagner, Eberhard: Einführung in die Elektrotechnik, Lehr- und Arbeitsbuch, Verlag Technik, 1991, 13th edition von Weiss, Alexander: Allgemeine Elektrotechnik, Vieweg Weißgerber, Wilfried: Elektrotechnik für Ingenieure. Band 1-3, Springer Vieweg, (latest edition)

[*updated 08.01.2020*]

Fundamentals of Energy Systems

Module name (EN): Fundamentals of Energy Systems
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2403
Hours per semester week / Teaching method: 5V+1U (6 hours per week)
ECTS credits: 6
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: EE1404 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 4, mandatory course E2403 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 90 class hours (= 67.5 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 112.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Stefan Winternheimer
Lecturer: Prof. Dr.-Ing. Stefan Winternheimer [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have basic knowledge about electrical power engineering. They will be able to identify the structure of electrical power supply networks and all essential operating components. Students will have basic knowledge of the stationary operating behavior of DC, synchronous and asynchronous machines. In power electronics, they will be able to describe the circuits of externally controlled power converters and calculate their characteristic values. [*updated 08.01.2020*]

Module content:
1. Three-phase systems: single/three-phase systems, power, voltage stability, stability, power transmission 2. Electrical power supply networks: network topologies, voltage levels, sub-networks, auxiliary networks, interconnected operation, transport networks, distribution networks, network regulation 3. Transformers: alternating/three-phase current transformer, vector groups, core construction, two/three-winding transformer, equivalent circuit diagram, no-load/short-circuit impedance, power consumption and voltage change under load, autotransformers, tap-changers, parallel connection of transformers 4. Methods for calculating steady, symmetrical network states: numerical equipment model, complex AC calculation in single-phase and multi-phase networks

[*updated 08.01.2020*]

Teaching methods/Media:
Lectures note as a PDF, projector

[*updated 08.01.2020*]

Recommended or required reading:
Flosdorff, René; Hilgarth, Günther: Elektrische Energieverteilung, Teubner, (latest edition) Happoldt, Hans; Oeding, Dietrich: Elektrische Kraftwerke und Netze, Springer, 1978 Heuck, Klaus; Dettmann, Klaus-Dieter: Elektrische Energieversorgung, Springer Vieweg, (latest edition) Schlabbach, Jürgen: Elektroenergieversorgung, VDE, 2003, 2. Aufl.

[*updated 08.01.2020*]

Fundamentals of High-Voltage Engineering and Test Engineering

Module name (EN): Fundamentals of High-Voltage Engineering and Test Engineering

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2605

Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)

ECTS credits: 5

Semester: 6

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam, practical exam with composition (3 lab experiments, ungraded)

Curricular relevance:
E2605 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Marc Klemm

Lecturer: Prof. Dr. Marc Klemm

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will have acquired basic knowledge from the field of high-voltage engineering and be able to solve basic high-voltage tasks. They will be able to set up and carry out experiments with the equipment commonly used in high-voltage laboratories and evaluate the results.

[*updated 08.01.2020*]

Module content:
- Field calculation: Basic laws of electrostatics: flux model; boundary layer behavior; divergence, Poisson´s and Laplace´s differential equation; examples of simple fields: homogeneous field; space charge; spherically and cylindrically symmetric field structures; representing fields - Dielectrics in general; polarization; dissipation, tan ; stratification; frequency dependence of material properties, temperature behavior - Mechanics of materials: Gaseous insulators: Towensend´s theory, Paschen´s law; Channel theory; breakdown at medium impact; liquid insulators; solid insulators - Fundamentals of high voltage transmission, cables and overhead lines, HVDC

[*updated 08.01.2020*]

Teaching methods/Media:
Blackboard, transparencies, presentations, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Beyer, Manfred; Zaengl, Walter; Boeck, Wolfram; Möller, Klaus: Hochspannungstechnik, Springer, 1986 Böhme, Helmut: Mittelspannungstechnik, Verlag Technik, Berlin, 2005, 2. Aufl. Hilgarth, Günther: Hochspannungstechnik, Teubner, 1997, 3. Aufl. Küchler, Andreas: Hochspannungstechnik, Springer, (latest edition) Sirotinski, L.J.: Hochspannungstechnik, Band 1 & 2, VEB Verlag Technik, Berlin

[*updated 08.01.2020*]

Fundamentals of Information Technology

Module name (EN): Fundamentals of Information Technology
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2411
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2411 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: N.N.
Lecturer: N.N. [*updated 10.09.2018*]
Learning outcomes: This lecture is aimed at students specializing in Energy Systems. After successfully completing this course, students will be familiar with the basics of information technology that are relevant to their area of specialization. Students will be familiar with the advantages and disadvantages of common systems of telecommunications technology. They will be familiar with the many possibilities of wired and wireless communication technologies and be able to select and use a suitable technology for the control and monitoring of energy systems. Students will be familiar with the principle and techniques of cellular network construction in mobile communications. They will be able to distinguish between different system generations in mobile communications and explain their common features. Students will be familiar with the relevant standards for communication in energy networks. They will be able to apply these standards in order to ensure secure and reliable network operation. Students will be able to use IT security standards to establish a secure encrypted network connection. [*updated 08.01.2020*]

Module content:
1. Signal classification 2. Frequency ranges, antennas, multiple access methods 3. Wired communication technologies 3.1 Analogue telephony (POTS), setting up a telephone connection line network 3.2 Digital telecommunication network (ISDN), services, network access, signaling, basic access, subscriber access interfaces 3.3 xDSL, ADSL, HDSL, VDSL, DSLAM 3.4 Passive optical networks, Ethernet and Gigabit PON, OLT, splitters, ONT 3.5 Copper lines, transmission characteristics, attenuation, crosstalk 3.6 Fiber optic cables, multi-mode fiber, single-mode fiber, DWDM technology, MUX, DEMUX, EDFA 3.7 Audio frequency ripple control, principle, transmitter, receiver, applications 3.8 Power Line Communication (PLC) 3.9 Ethernet, IEEE Standard 802.3 4. Wireless communication technologies 4.1 Mobile networks (1G, 2G (GSM), 2.5G, 3G (UMTS/HSDP), 4G (LTE/LTE-A) 4.2 Satellite communications, satellite orbits, satellite radio services, frequencies and bands, international satellite systems 4.3 WLAN, characteristics, network structure, IEEE standard 802.11, DSSS, planning WLANs 4.4 Bluetooth, IEEE Standard 802.15.1, FHSS, Pico and Scatternet 5. Network technology 5.1 OSI reference model 5.2 IP networks, protocol family TCP/IP, IPv4, IPv6 5.3 IEC 61850 Standard 6. IT security 6.1 Internet Protocol Security (IPsec) 6.2 MD5 and SHA hash functions
6.3. Wi-Fi Protected Access (WPA) 6.4. Virtual Private Network (VPN)

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation with board and beamer during lecture

[*updated 08.01.2020*]

Recommended or required reading:
Badach, Anatol; Hoffman, Erwin: Technik der IP-Netze, Hanser, München, (latest edition) Benkner, Thorsten: Grundlagen des Mobilfunks, Schlembach, 2007, 1. Aufl., ISBN 978-3935340441 Bluschke, Andreas; Matthews, Michael: xDSL-Fibel, VDE, 2008 Dahlman, Eric; Parkvall, Stefan; Skold, Johan: 4G, LTE-Advanced Pro and the Road to 5G, Academic Press, 2016, ISBN 978-0128045756 Dodel, Hans: Satellitenfrequenzkoordinierung, Springer Vieweg, 2012, ISBN 978-3-642-29202-6 Dodel, Hans: Satellitenkommunikation, Springer, 2007, 2. Aufl., ISBN 978-3-540-29575-4 Freyer, Ulrich: Nachrichtenübertragungstechnik, Hanser, (latest edition) Gessler, Ralf; Krause, Thomas: Wireless-Netzwerke für den Nahbereich, Vieweg + Teubner, (latest edition) Jondral, Friedrich: Nachrichtensysteme, Schlembach, 2001 Korhonen, Juha: Introduction to 3G mobile communications, Artech House, 2003 Mertz, Andreas; Pollakowski, Martin: xDSL & Access networks, Prentice Hall, 2000 Obermann, Kristof; Horneffer, Martin: Datennetztechnologien für Next Generation Networks, Springer Vieweg, 2013, 2. Aufl., ISBN 978-3-8348-1384-8 Paessler, Ernst-Robert: Rundsteuertechnik, Publicis MCD, 1994 Sauter, Martin: Grundkurs Mobile Kommunikationssysteme, Springer Vieweg, (latest edition) Schwenk, Jörg: Sicherheit und Kryptographie im Internet, Vieweg, (latest edition), ISBN 978-3-658-06543-0 Siegmund, Gerd: Technik der Netze, Hüthig Werner, Martin: Nachrichtentechnik, Vieweg, (latest edition)

[*updated 08.01.2020*]

High and Ultra-High Frequency Engineering

Module name (EN): High and Ultra-High Frequency Engineering
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2512
Hours per semester week / Teaching method: 4V+1U (5 hours per week)
ECTS credits: 6
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2512 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 75 class hours (= 56.25 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 123.75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martin Buchholz
Lecturer: Prof. Dr. Martin Buchholz [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this module, students will be able to name the basic challenges of high-frequency and microwave technology. - They will understand and be able to evaluate the characteristics of processing high-frequency signals and wire-bound or radio-based transmission. - Students will have mastered the techniques required to independently perform the typical tasks in high-frequency engineering, such as optimizing power parameters, calculating matching networks and specifying a transmission line. - Students will be able to use common computer-aided calculation and design tools. - They will be able to deal with scattering parameters and set up the scattering matrix for active and passive high-frequency assemblies. - Students will be able to describe the differences between an electro-magnetic near field and far field. - They will be able to analyze how an antenna works and characterize the antenna metrologically. - Students will understand the basic principles of transmission on optical fibers and in optical networks. - They will be able to explain a complete optical transmission line. - Students will be able to evaluate the current technical data of optical components and systems. - And use the acquired skills to specify an optical transmission line.

[*updated 08.01.2020*]

Module content:
1. Introduction to high frequency engineering 2. Transmission line theory 3. Wave propagation on Lecher lines 4. Impedance transformation 5. Matching and transformation circuits 6. Line diagrams 7. Scattering parameters 8. Waveguides 9. Resonators - coupled bandpass filters 10. Striplines - microstrip and stripline 11. Radio tranmsmission theory 12. Hertz dipole, far and near field 13. Antennas 14. Passive and active components of HF technology - filters, mixers, insulators, circulators, directional couplers, oscillators 15. Optical waveguides 16. Optical transmitters, amplifiers and receivers 17. Optical communications and metrology

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, video projector, explanatory videos, Turning Point Interactive Learning System

[*updated 08.01.2020*]

Recommended or required reading:
Brückner, Volker: Optische Nachrichtentechnik, Grundlagen und Anwendungen, Vieweg, 2003 Detlefsen, Jürgen; Siart, Uwe: Grundlagen der Hochfrequenztechnik, Oldenbourg, (latest edition) Geißler, Rainer; Kammerloher, Werner; Schneider, Hans W.: Berechnungs- und Entwurfverfahren der Hochfrequenztechnik, Vieweg Heuermann, Holger: Hochfrequenztechnik: Lineare Komponenten hochintegrierter Hochfrequenzschaltungen, Vieweg, 2005, 1. Aufl. Kark, Klaus: Antennen und Strahlungsfelder: Elektromagnetische Wellen auf Leitungen, im Freiraum und ihre Abstrahlung, Vieweg, 2006, 2. Aufl. Meinke, Hans-Heinrich: Taschenbuch der Hochfrequenztechnik, Springer, (latest edition) Pehl, Erich: Mikrowellentechnik: Grundlagen, Leitungen, Antennen, Anwendungen, VDE, (latest edition) Schiffner, Gerhard: Optische Nachrichtentechnik: Physikalische Grundlagen, Entwicklung, moderne Elemente und Systeme, Teubner, 2005, ISBN 978-3519004462 Voges, Edgar: Hochfrequenztechnik: Bauelemente, Schaltungen, Anwendungen, Hüthig, 2004, ISBN 978-3826650390 Voges, Edgar; Petermann, Klaus: Optische Kommunikationstechnik, Handbuch für Wissenschaft und Industrie, Springer, (latest edition) Zinke, Otto; Brunswig, Heinrich: Hochfrequenztechnik 1: Hochfrequenzfilter, Leitungen, Antennen,, Springer, 1999, ISBN 978-3540664055 Zinke, Otto; Brunswig, Heinrich: Hochfrequenztechnik 2: Elektronik und Signalverarbeitung, Springer, 1998, ISBN 978-3540647287

[*updated 08.01.2020*]

Industrial Control Technology

Module name (EN): Industrial Control Technology

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2404

Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)

ECTS credits: 5

Semester: 4

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2404 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Benedikt Faupel

Lecturer: Prof. Dr. Benedikt Faupel

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will able to describe the structure and functionality of industrial control systems and explain typical devices and assemblies of industrial control technology. They will be able to apply known logical instructions and common data types for the description of control processes to predefined function and process descriptions. Students will be able to design their own solutions in standardized programming languages according to DIN-EN 61131-3 of control technology and will have the opportunity to implement and test these solutions on laboratory development systems.

[*updated 08.01.2020*]

Module content:
1. Introduction and motivation / History / Market situation 2. Principals of control technology: Terms / Structure of PLC systems / Areas of application for PLC systems / System architecture of automation solutions 3. Standards and guidelines according to DIN-EN 61131 4. Overview of automation devices and hardware product families: Controllers / Signal modules / Function modules / Communication modules / Decentralized hardware / Hardware project planning / Classic and TIA portal engineering tools 5. Structure and mode of operation of PLC programs: Programming languages (FBD, LD, IL) / STEP7 and CoDeSys operation pool / Binary signal processing / Analog signal processing / Storage, archiving program documentation / Test and online functions / Program simulation / Error diagnosis and handling 6. Programming strategies: Module overview (OB, FB, FC, DB, UDT) / Global and local variable declarations / Symbol table / Sequence programming with S7 graph / Diagnostics with error OBs 7. Communication systems: Basics of field bus systems (Profibus-DP, Profibus-FMS, Profibus-PA) / Decentralized system architecture / Automation pyramid / Devices and components 8. Operating and monitoring: Tasks / Visualization tools (WinCC, WinCC-flexible)

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Berger, Hans: Automatisieren mit SIMATIC S7-1500, Publicis MCD, 2017, 2. Aufl., ISBN 978-3-8957-8451-4 Seitz, Matthias: Speicherprogrammierbare Steuerungen für die Fabrik- und Prozessautomation, Hanser, (latest edition) Wellenreuther, Günter; Zastrow, Dieter: Automatisieren mit SPS - Theorie und Praxis, Vieweg, Wiesbaden, (latest edition) Wellenreuther, Günter; Zastrow, Dieter: Automatisieren mit SPS - Übersichten und Übungsaufgaben, Vieweg, Wiesbaden, (latest edition)

[*updated 08.01.2020*]

Information Technology - Lab Course

Module name (EN): Information Technology - Lab Course
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2513
Hours per semester week / Teaching method: 5P (5 hours per week)
ECTS credits: 6
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Oral examination, practical test with term paper (lab, no grade)
Curricular relevance: E2513 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 75 class hours (= 56.25 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 123.75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker
Lecturer: Prof. Dr. Horst Wieker [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to analyze and independently solve practical tasks in telecommunication-specific fields of work. (Technical competence: 4 ECTS, Methodological competence: 1 ECTS) They will be able to carry out the tasks in a team (including preparation, execution and documentation of lab work, using modern measuring methods and instruments) and prepare technical documentation. (Social competence: 1 ECTS) [*updated 08.01.2020*]

Module content:
The given content represents the basic tasks in the practical exercises. This involves solving and documenting both simple, individual tasks and complex, cross-content tasks. 1. Protocol analysis of TDM telecommunication systems 2. Planning and designing IP networks (logical structure, switching, routing) 3. Traffic engineering and performance monitoring by means of management systems 4. Protocol analysis of mobile radio systems 5. Structure of a VoIP system 6. IP security

[*updated 08.01.2020*]

Teaching methods/Media:
Beamer, blackboard, practical work on real network elements and networks.

[*updated 08.01.2020*]

Recommended or required reading:
Badach, Anatol: Voice over IP - die technik, Hanser, 2007, 3. Aufl. Badach, Anatol; Hoffman, Erwin: Technik der IP-Netze, Hanser, München, (latest edition) Chapell, Laura A.: Wireshark 101, mitp, 2013 Siegmund, Gerd: Technik der Netze, Hüthig

[*updated 08.01.2020*]

Information Technology and Systems 1

Module name (EN): Information Technology and Systems 1
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2407
Hours per semester week / Teaching method: 3V (3 hours per week)
ECTS credits: 4
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2407 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 45 class hours (= 33.75 clock hours) over a 15-week period. The total student study time is 120 hours (equivalent to 4 ECTS credits). There are therefore 86.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker
Lecturer: Prof. Dr. Horst Wieker [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to fundamentally describe existing communication networks and analyze extended, optimized and new communication networks with regard to their structure and function. They will have basic knowledge about abstracting networks and will be able to show correlations (similarities and differences) on the basis of theoretical layer models. [*updated 08.01.2020*]

Module content:
1. Basic descriptions and classifications of communication networks (definition, topologies, spatial extension, type of transmission, connectionless, connection-oriented) 2. Fundamentals of data transmission (synchronous, asynchronous, directional, bandwidth and latency, access methods) 3. Characterization of communication processes (number of communication partners, transmission methods, interfaces, one and two-way communication, delivery sequences, network security)4. Transmission media and channel formation via multiplexing (CU-DA, LWL, air, time, frequency, code and space division multiplex, modulation) 5. Protocols and reference models (layer models, vertical and horizontal communication, the service term, service handover points) 6. Addressing, routing and switching techniques (routing and switching in communication networks)

[*updated 08.01.2020*]

Teaching methods/Media:
Beamer, board

[*updated 08.01.2020*]

Recommended or required reading:
Badach, Anatol; Hoffman, Erwin: Technik der IP-Netze, Hanser, München, (latest edition) Krüger, Gerhard: Lehr- und Übungsbuch Telematik, Hanser, 2004, 3. Aufl. Orlamünder, Harald: Paket-basierte Kommunikationsprotokolle, Hüthig, Bonn, 2005, 1. Aufl. Siegmund, Gerd: Technik der Netze, Hüthig Stevens, W. Richard: TCP/IP, Hüthig, Heidelberg, 2008 Werner, Martin: Nachrichtentechnik, Vieweg, (latest edition)

[*updated 08.01.2020*]

Information Technology and Systems 2

Module name (EN): Information Technology and Systems 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2511
Hours per semester week / Teaching method: 4V (4 hours per week)
ECTS credits: 5
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Oral examination
Curricular relevance: E2511 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Horst Wieker
Lecturer: Prof. Dr. Horst Wieker [*updated 10.09.2018*]
Learning outcomes: This lecture is based on the technical skills and knowledge acquired in the lecture Communications Technology 1. After successfully completing this course, students will be able to fundamentally describe and understand the structure and functioning of different transmission and access networks. Furthermore, they will be able to classify and analyze functional extensions and optimizations of existing and new transmission and access networks with regard to the layers used in the OSI reference model. Students will have in-depth knowledge about the assignment of transmission networks in connection with the OSI reference model and the architecture of networks, their coupling and synchronization. (Technical competence: 3 ECTS) Finally, they will be able to apply their acquired knowledge to planning telecommunication networks in group work. (Social and personal competence 2 ECTS) [*updated 08.01.2020*]

Module content:
1. Transmission networks (PDH, SDH, OTN, Ethernet) 2. Coupling transmission networks (hub, switch, router, gateways) 3. Ethernet-based TCP/IP networks (IPv4/v6 addressing, network address formation, routing methods, Internet/Intranet via VLANs, VoIP) 4. Clocking and synchronization of transmission networks (clocking by means of frequency standards, clock preparation, master/slave method) 5. Signaling in transmission networks 6. Mobile networks (GSM-LTE) 7. Access networks (xDSL, broadband cable, HFC, FTTx, PON, SAT, radio relay systems)

[*updated 08.01.2020*]

Recommended or required reading:
Badach, Anatol; Hoffman, Erwin: Technik der IP-Netze, Hanser, München, (latest edition) Keller, Andres: Breitbandkabel und Zugangsnetze, Springer, 2011, 2. Aufl., ISBN 978-3642176302 Krüger, Gerhard: Lehr- und Übungsbuch Telematik, Hanser, 2004, 3. Aufl. Obermann, Kristof; Horneffer, Martin: Datennetztechnologien für Next Generation Networks, Springer Vieweg, 2013, 2. Aufl., ISBN 978-3-8348-1384-8 Sauter, Martin: Grundkurs Mobile Kommunikationssysteme, Springer Vieweg, (latest edition) Siegmund, Gerd: Technik der Netze, Hüthig Stevens, W. Richard: TCP/IP, Hüthig, Heidelberg, 2008

[*updated 08.01.2020*]

Integration-Compatible Circuitry

Module name (EN): Integration-Compatible Circuitry
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2610
Hours per semester week / Teaching method: 2V+2PA (4 hours per week)
ECTS credits: 5
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Presentation (20%), project (80%)
Curricular relevance: E2610 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): E2105 Digital Electronics E2303 Electronics 1 E2401 Electronics 2 E2408 CAD in Microelectronics [*updated 18.07.2019*]
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Albrecht Kunz
Lecturer: Prof. Dr. Albrecht Kunz [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have detailed, up-to-date knowledge about common circuit families. They will understand the differences between the different circuit families and can estimate and evaluate the limits and possibilities of the circuit families with the help of numerically generated simulation results. This will help students select suitable technologies for specific requirement profiles and thus, enable them to successfully work on future projects later in their careers. They will able to use the results of numerical simulations to their advantage in the run-up to technological implementations. [*updated 08.01.2020*]

Module content:
1. Introduction to simulation technology using the simulation tool OrCad Pspice from Cadence 2. Transistor models in Pspice, basic circuits used in simulations 3. Diode-transistor logic 4. TTL technology 5. Emitter-coupled logic, integrated injection logic 6. NMOS/PMOS - circuitry 7. CMOS technology 8. BiCMOS technology 9. Simulating application examples with OrCad Pspice

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, presentation, blackboard, projector, PC simulations

[*updated 08.01.2020*]

Recommended or required reading:
Baker, R. Jacob: CMOS: Circuit Design, Layout, and Simulation, Wiley, 2009, 2nd Ed. DeMassa, Thomas A.: Digital Integrated Circuits, John Wiley & Sons Ehrhardt, Dietmar: Integrierte analoge Schaltungstechnik: Technologie, Design, Simulation und Layout, Vieweg, 2000 Heinemann, Robert: PSPICE, Hanser, (latest edition) Jaeger, Richard C.: Microelectronic Circuit Design, McGraw-Hill, (latest edition) Post, Hans-Ulrich: Entwurf und Technologie hochintegrierter Schaltungen, Teubner, 1989 Razavi, Behzad: Fundamentals of Microelectronics, John Wiley & Sons, 2008 Rein, Hans-Martin; Ranfft, Roland: Integrierte Bipolarschaltungen, Springer, 1980 Uyemura, John P.: CMOS Logic Circuit Design, Kluwer, 1999 Wupper, Horst; Niemeyer, Ulf: Elektronische Schaltungen, Band 1 und 2, Springer, 1996

[*updated 08.01.2020*]

Laboratory Course in Automation Engineering

Module name (EN): Laboratory Course in Automation Engineering

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2603

Hours per semester week / Teaching method: 8P (8 hours per week)

ECTS credits: 8

Semester: 6

Mandatory course: yes

Language of instruction:
German

Assessment:
Oral examination, practical test with term paper (10 lab experiments, no grade)

Curricular relevance:
E2603 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course

Workload:
120 class hours (= 90 clock hours) over a 15-week period.
The total student study time is 240 hours (equivalent to 8 ECTS credits).
There are therefore 150 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Dietmar Brück

Lecturer: Prof. Dr.-Ing. Dietmar Brück

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will understand tasks from the fields of robotics, drive technology and control, microprocessor applications, operating systems and automation systems and be able to solve them independently and creatively. Our primary focus will be on the application of these skills. Students will have had the opportunity to improve their team work and self-organization skills.

[*updated 08.01.2020*]

Module content:
In the course of 14 lab sessions, this practical course will allow students to use the applications discussed in the following lectures: Mikroprozessoren und Anwendungen I and II, Signal- und Bildverarbeitung, Industrielle Steuerungstechnik und Regelungstechnik I and II 1. Drive control using various PLC systems 2. Image processing with industrial systems 3. Controlling robots for various tasks 4. Using a microcontroller in measurement science and control engineering. 5. Introduction to PLC technology 6. Sequence programming with S7-Graph 7. Visualization with WinCC / WinCC flexible

[*updated 08.01.2020*]

Teaching methods/Media:
Practical lab course

[*updated 08.01.2020*]

Recommended or required reading:
Berger, Hans: Automatisierung mit STEP 7 in AWL und SCL, Publicis MCD, Erlangen, (latest edition) Bode, Helmut: MATLAB in der Regelungstechnik, Teubner, Leipzig, 1998 Grupp Frieder; Grupp Florian: MATLAB für Ingenieure, Oldenbourg, München, (latest edition) Horacher, Martin: Mikrocomputer, TU Wien, 1999 Johannis, Reiner: MC-Tools 15, Feger, 1994 Klaus, Rolf: Der Mikrocontroller C167, VDF Hochschulverlag, 2000 Schneider, Ekkehard: Methoden der Automatisierung, Vieweg, Braunschweig, 1999, ISBN 978-3528065669 Schultes, Renate; Pohle, Ingo: 80C166 Mikrocontroller, Franzis, 1998, ISBN 978-3772358937

[*updated 08.01.2020*]

Measurement and Instrumentation Engineering 1

Module name (EN): Measurement and Instrumentation Engineering 1
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2203
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical examination with report (lab, ungraded)
Curricular relevance: E2203 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 2, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Oliver Scholz
Lecturer: Prof. Dr. Oliver Scholz [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this module: - students will have basic knowledge of metrology (e.g. can list the basic principles of the International System of Units (SI), can confidently use and carry out calculations with quantities and their units), - they will be familiar with simple, common methods and procedures for measuring electrical (direct current) quantities, - they will be able to distinguish between known systematic measurement deviations and those of a random nature, - students will be able to calculate the propagation of known systematic (influence analysis) and random (Gaussian error propagation) measurement deviations, - they will be able to name basic measurement methods, list examples and classify them qualitatively, - Students will have mastered the setup for measuring electrical resistance correctly, they will be able to quantify systematic errors in specific cases and make well-founded statements as to when the current correct measurement method is preferable to the voltage correct measurement method. - They will be able to explain and use the metrological terms "accuracy", "trueness" and "precision". - They will be able to divide the characteristic curve of a measuring apparatus or sensor into error categories and determine the respective deviation components, - Students will be able to calculate the maximum permissible measuring deviation of analog and digital measuring instruments on the basis of the scale markings or manufacturer´s specifications, - They will be able to calculate the maximum deviation based on the quantization of a physical quantity using the resolution and enumerate the characteristic errors of a non-ideal quantizer, - They will be familiar with the construction and analysis of a Wheatstone bridge and can determine and correct the measurement deviation based on the finite internal resistance of an ammeter or voltmeter of a deflection bridge, - Students will be familiar with the structure and analysis of a Kelvin bridge and can determine when a Kelvin bridge is most suitable, - They will have mastered the design and analysis of 2, 3 and 4-wire sensing for measuring resistances, and can also calculate the error if, for example, an amplifier has a finite input resistance, - They will be proficient in the basic handling and use of simple measuring instruments in the laboratory (multimeter, power supply unit, oscilloscope, function generator) and can construct simple measuring circuits independently,- Students will be able to use strain gage measurement to easily determine mechanical quantities, - They will be able to perform simple regression analyses from measurement curves using predefined formulas. - Students will be able to draw and label measurement curves and associated coordinate systems in a professional manner,- They will be able to familiarize themselves with new topics within a limited period of time using a range of technical and reference books and then be able to extract and apply the information necessary for solving simple tasks. Students will be able to plan, organize and carry out measurement tasks in small groups.

[*updated 08.01.2020*]

Module content:
Principles of metrology - motivation, SI units, ... Error analysis - systematic errors, random errors, error propagation, ... Measuring instrument technology - analog, digital, ... Measuring basic electrical quantities (with direct current) - voltage, current, resistance, ...

[*updated 08.01.2020*]

Teaching methods/Media:
Slides, lab guides, exercises and videos; all materials can be accessed electronically by students. The module combines lecture and lab components. The lab component consists of 5 compulsory sessions. Experiments will be carried out in groups of two, preparation for the lab sessions will be checked individually. A report must be written for each lab experiment. These reports must be personally presented to the lecturer/supervisor. In the lab sessions, students will carry out various measuring tasks on real objects and devices without demonstration, but according to instructions. A supervisor will be available to assist them, if needed.

[*updated 08.01.2020*]

Recommended or required reading:

Benesch, Thomas: Schlüsselkonzepte zur Statistik: die wichtigsten Methoden, Verteilungen, Tests anschaulich erklärt, Spektrum, 2013, ISBN 978-3827427717 Daehn, Wilfried: Testverfahren in der Mikroelektronik, Springer, 1997 Dankert, Jürgen; Dankert, Helga: Technische Mechanik, Springer Vieweg, 2013, 7. Aufl., ISBN 978-3-8348-1809-6 Hoffmann, Jörg: Taschenbuch der Messtechnik, Hanser, (latest edition) Hoffmann, Karl: Eine Einführung in die Technik des Messens mit Dehnungsmessstreifen, Hottinger Baldwin Messtechnik, 1987 Kohlrausch, Friedrich: Praktische Physik, Teubner, Stuttgart, 1996, 24. Aufl., ISBN 3-519-23001-1 Lerch, Reinhardt: Elektrische Messtechnik, Springer, (latest edition) Mühl, Thomas: Einführung in die elektrische Messtechnik, Teubner, (latest edition) Schrüfer, Elmar: Elektrische Messtechnik, Hanser, (latest edition)

[*updated 08.01.2020*]

Measurement and Instrumentation Engineering 2

Module name (EN): Measurement and Instrumentation Engineering 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2302
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 3
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical examination with report (lab, ungraded)
Curricular relevance: E2302 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: E2408 CAD in Microelectronics [*updated 18.07.2019*]
Module coordinator: Prof. Dr. Oliver Scholz
Lecturer: Prof. Dr. Oliver Scholz [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be: - able to calculate the root-mean-square value of any time-dependent quantity, - able to determine undulating currents and voltages from the separate measurement of zero frequency and periodic quantities, - familiar with the definitions for mean value, rectified value, root-mean-square value, form factor and peak factor and be able to explain their meaning. - able to identify the problems that can arise from the use of certain measuring elements/instruments in connection with the measurement of time-varying electrical quantities and take them into account in measurements, - able to calculate field and performance quantities in the pseudo-units Bel, Decibel and Neper forward and backward, - able to calculate with quantities in the above-mentioned pseudo-units,
- able to outline the basic structure of a spectrum analyzer and outline the significance of its individual components, - able use the basic functions of a spectrum analyzer, including the appropriate selection and adjustment of e.g. the center frequency and frequency range, the vertical resolution, the resolution bandwidth, the discriminator, the video bandwidth, - able to safely use instrument transformers for current and voltage measurements and quantify their measurement errors, - able to measure or calculate unknown AC resistances using various AC bridges and/or oscilloscopes, - able to calculate loss factors and qualities of alternating current resistances and identify them by way of measurement, - able to explain how modern LCR meters work, - able to to determine the mutual inductance of two coupled coils by measurement, - able to carry out power measurements (apparent, reactive and active power) in a single- and three-phase system (with or without neutral conductor), - able to calculate the power in corresponding single-phase and three-phase networks, - able to describe how a Ferraris meter works, - able to name, compare and roughly evaluate common methods of temperature measurement and their mode of operation to ascertain which method is suitable for a specific purpose, - able to measure static magnetic fields using a field coil and integrator (strength and direction), - able to use acceleration sensors to measure inclination and rotational speed, - able to calibrate sensors, - able to interpret their measurement results and explain the corresponding calculations. - able to independently plan, organize and carry out measurement tasks in small groups, - able to operate more complex measuring equipment,

[*updated 08.01.2020*]

Module content:
- Time-varying signals - Measurement of electrical quantities (alternating and mixed current) such as impedances, power, electrical work and associated measuring instrument technology - Level calculation, - The function and application of a spectrum analyzer, - Extended measuring circuits, such as the Maxwell-Wien bridge, etc. - Instrument transformers - Measuring temperatures

[*updated 08.01.2020*]

Teaching methods/Media:
Slides, lab guides, exercises and videos; all materials can be accessed electronically by students. The module combines lecture and lab components. The lab component consists of 5 compulsory sessions. Experiments will be carried out in groups of two, preparation for the lab sessions will be checked individually. A report must be written for each of the lab experiments. These reports must be personally presented to the lecturer/supervisor. In the lab sessions, students will carry out various measuring tasks on real objects and devices without demonstration, but according to instructions. A supervisor will be available to assist them, if needed.

[*updated 08.01.2020*]

Recommended or required reading:
Felderhoff, Rainer; Freyer, Ulrich: Elektrische und elektronische Messtechnik, Hanser, München, Wien, 2007, 8. Aufl. Harten, Ulrich: Physik - eine Einführung für Ingenieure und Naturwissenschaftler, Springer Vieweg, Berlin Hoffmann, Jörg: Taschenbuch der Messtechnik, Hanser, (latest edition) Irrgang, Klaus: Zur Temperaturmessung elektrischer Berührungsthermometer, Wiss.-Verl. Ilmenau, Ilmenau, 2005, ISBN 3-936404-08-9 Lerch, Reinhardt: Elektrische Messtechnik, Springer, (latest edition) Lüke, Hans-Dieter; Ohm, Jens-Rainer: Signalübertragung - Grundlagen der digitalen und analogen Nachrichtenübertragungssysteme, Springer, (latest edition) Mühl, Thomas: Einführung in die elektrische Messtechnik, Teubner, (latest edition) Schrüfer, Elmar: Elektrische Messtechnik, Hanser, (latest edition)

[*updated 08.01.2020*]

Microcontrollers and Applications 1

Module name (EN): Microcontrollers and Applications 1

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2501

Hours per semester week / Teaching method: 2V+1P (3 hours per week)

ECTS credits: 4

Semester: 5

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2501 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course

Workload:
45 class hours (= 33.75 clock hours) over a 15-week period.
The total student study time is 120 hours (equivalent to 4 ECTS credits).
There are therefore 86.25 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Dietmar Brück

Lecturer: Prof. Dr.-Ing. Dietmar Brück

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be familiar with how microprocessors and microcontrollers work, in particular the interaction of hardware and software components. Students will be able to understand a microcontroller system and put it into operation for a given task. This module focuses on application-relevant aspects. Students will be able to independently find solutions to new tasks.

[*updated 08.01.2020*]

Module content:
1. Introduction to digital technology with calculation and memory circuits, decoding, basic structure of a microcomputer with RAM, ROM and I/O components, program sequence, timing diagrams, interrupt handling, wait states 2.Structure of the experimental computer board with the Infineon C515C controller, functionality of the controller, signal assignment and interconnection of signals, functionality of the integrated unit 3.Interaction of the microcontroller with integrated peripheral components such as parallel interfaces 4.Work on the experimental computer board based on guided exercises

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Horacher, Martin: Mikrocomputer, TU Wien, 1999 Johannis, Reiner: MC-Tools 15, Feger, 1994 Klaus, Rolf: Der Mikrocontroller C167, VDF Hochschulverlag, 2000 Schultes, Renate; Pohle, Ingo: 80C166 Mikrocontroller, Franzis, 1998, ISBN 978-3772358937

[*updated 08.01.2020*]

Microcontrollers and Applications 2

Module name (EN): Microcontrollers and Applications 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2601
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2601 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Dietmar Brück
Lecturer: Prof. Dr.-Ing. Dietmar Brück [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to understand a microcontroller system and commission it for a given task. This module focuses on application-relevant aspects. Students will be able to independently find solutions to new tasks.Based on the previous lecture, this module will familiarize students with the applications of microcontrollers in defined areas of automation technology. The interaction of relevant peripheral components will be explained in detail and students will be able to practice their use based on examples. Students will be able to understand a microcontroller system in an automation application with its interfaces to bus systems and commission it for a given task. Our primary focus will be on the application of these skills. [*updated 08.01.2020*]

Module content:
1. How integrated units work, Processing commands, Command range and memory access options, Using the ECB for simple tasks in automation and measurement technology, Specifying a task and creating programs 2. Using an assembler, Transferring the created programs into the target system and testing programs for functionality and completeness 3. Using bus systems, as well as networks and the connection to the ECB 4. In addition to the lectures, the effects of individual components will be investigated in depth in the lab through practical exercises and projects.

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Horacher, Martin: Mikrocomputer, TU Wien, 1999 Johannis, Reiner: MC-Tools 15, Feger, 1994 Klaus, Rolf: Der Mikrocontroller C167, VDF Hochschulverlag, 2000 Schultes, Renate; Pohle, Ingo: 80C166 Mikrocontroller, Franzis, 1998, ISBN 978-3772358937

[*updated 08.01.2020*]

Microelectronics Lab Course

Module name (EN): Microelectronics Lab Course

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2613

Hours per semester week / Teaching method: 5P (5 hours per week)

ECTS credits: 5

Semester: 6

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
E2613 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course

Workload:
75 class hours (= 56.25 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 93.75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Volker Schmitt

Lecturer: Prof. Dr. Volker Schmitt

[*updated 10.09.2018*]

Learning outcomes:
In this module, students will work together in a group on a project to design a more complex electronic system. In doing so, they will apply the knowledge acquired in lectures to carry out a design task from the specification of requirements to a functional sample. For this purpose, they will independently design the necessary electronic circuits and test them in simulations. They will compile, interpret and evaluate the results obtained. Students will plan their implementation on the printed circuit board and create the layout using EDA software. To do so, they must apply their knowledge of enclosure, assembly and connection technology in order to obtain a working sample that can be metrologically tested in the lab. In addition to practical skills in manufacturing electronic circuits and using measuring instruments, students will practice presenting and discussing their solutions in their group during project development.

[*updated 08.01.2020*]

Module content:
Practical work on topics in the laboratory from the areas of general electronics, microelectronics, transmission technology and control technology.

[*updated 08.01.2020*]

Teaching methods/Media:
Templates and task sheets in electronic form, PC, projector, Spice-based simulation tools (PSPICE or LTSpice), Eagle layout tool, VHDL simulator.

[*updated 08.01.2020*]

Recommended or required reading:
Best, Roland: Phase-Locked Loops, Design, Simulation and Applications, McGraw-Hill, 2007 Beuth, Klaus: Elektronik: Band 2: Bauelemente, Vogel, (latest edition) Brückner, Volker: Optische Nachrichtentechnik, Grundlagen und Anwendungen, Vieweg, 2003 Hayward, Wes H.: Introduction to Radio Frequency Design, Amer Radio Relay League, 1982 Heinemann, Robert: PSPICE, Hanser, (latest edition) Krups, Robert: SMT-Handbuch, Vogel, 1991 Lee, Thomas H.: The Design of CMOS Radio-Frequency Integrated Circuits, Cambridge University Press, 2003, 2nd Ed. Leibner, Peter: Rechnergestützter Schaltungsentwurf, Krehl, Münster, 1996, 1. Aufl. Mandl, Matthew: Priciples of Electronic Communications, Prentice Hall, 1973 Nolde, Ralf: SMD-Technik, Franzis, 1994 Paul, Reinhold: Einführung in die Mikroelektronik, Hüthig, 1985 Reichl, Herbert: Hybridintegration, Hüthig Stephens, Donald R.: Phase-Locked Loops for Wireless Communications, Kluwer Strauss, Rudolf: SMD Oberflächenmontierte Bauteile, VTT, 1989 Tietze, Ulrich; Schenk, Christoph: Halbleiterschaltungstechnik, Springer, (latest edition)

[*updated 08.01.2020*]

Physics 2

Module name (EN): Physics 2

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2202

Hours per semester week / Teaching method: 4V+1U (5 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2202 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 2, mandatory course

Workload:
75 class hours (= 56.25 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 93.75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Barbara Hippauf

Lecturer: Prof. Dr.-Ing. Barbara Hippauf

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will: be able to set up differential equations for second-order systems, explain their solutions and carry them out using examples. They will be familiar with analogy systems from mechanics and electrical engineering. - Students will have learned how the methods can be transferred to coupled and higher order systems. - They will have learned about the propagation of different physical quantities over waves. They will be familiar with the general wave equation as a differential equation and be able to apply it. Students will understand the superposition of waves and its effects. - They will be familiar with the propagation of light as a beam and understand the terms reflection, total internal reflection and refraction. They will be able to describe and calculate images on mirrors, lenses and lens combinations geometrically and mathematically. They will be able to explain the structure of optical devices and how they work. - Students will be familiar with the limits of ray optics. They will be able to use the wave-like nature of light to explain and apply interference and diffraction phenomena such as, for example, limiting the resolving power of optical devices. - Students will be familiar with the structure of the hydrogen atom in the Bohr model via classical physics. And using this knowledge, be able to explain the shell model, energy levels and spectra. Students will know how X-rays are generated and applied. They will be able to explain the photoelectric effect with light as particles.

[*updated 08.01.2020*]

Module content:
Oscillations Setting up differential equations for different types of oscillations using examples in different mechanical and electronic systems, Solutions in the undamped and damped spring-mass-system, Forced oscillation in the spring-mass system, Solution using a complex approach, Amplitude response and phase response, Higher order systems, Two coupled oscillators, Differential equations, Beat, In-phase and out-of-phase oscillations, couplings of more than two oscillators Waves Propagating waves of different physical quantities, General wave equation, Superposition of waves, Standing wave, Interference, Amplitude modulation, Frequency modulation, Optics Propagation of light in a medium, Laws of reflection and refraction, Mirrors, Lenses in geometric optics, Newton´s lens equation, Combination of lenses, Structure of the eye, Magnifying glass, Microscope, Telescope, Analog and digital camera, Light as waves, Phase and group velocity, Polarization, Huygens´ principle, Diffraction at a slit, Interference at double slit and grating, Newtonian rings, Resolution of optical instruments Atomic physics Bohr model, Energy levels in hydrogen atom, Generating X-rays, Applying X-rays, in particular Bragg reflection in X-ray diffraction and scanning electron microscope, Photoelectric effect, Photons, Quantum of action Thermally generated emission of electrons, Heat transfer via radiation

[*updated 08.01.2020*]

Teaching methods/Media:
Blackboard, lecture notes, presentations

[*updated 08.01.2020*]

Recommended or required reading:
Hering, Ekbert; Martin, Rolf; Stohrer, Martin: Physik für Ingenieure, Springer Vieweg, (latest edition) Hering, Ekbert; Martin, Rolf; Stohrer, Martin: Taschenbuch der Mathematik und Physik, Springer Vieweg Turtur, Claus Wilhelm: Prüfungstrainer Physik, Springer Spektrum

[*updated 08.01.2020*]

Physics1

Module name (EN): Physics1
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2102
Hours per semester week / Teaching method: 4V+1U (5 hours per week)
ECTS credits: 5
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2102 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 1, mandatory course
Workload: 75 class hours (= 56.25 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 93.75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: E2204 Fundamentals of Electrical Engineering 2 [*updated 05.10.2019*]
Module coordinator: Prof. Dr.-Ing. Barbara Hippauf
Lecturer: Prof. Dr.-Ing. Barbara Hippauf [*updated 10.09.2018*]

Learning outcomes:
- After successfully completing this course, students will be familiar with kinematic quantities and how they are connected. They will be able to set up equations of motion for different movements and, with regard to different reference systems, use them to find solutions. Students will learn to split complex movements into partial, simple movements by applying superposition. - They will be familiar with force and impulse as physical variables and using them, be able to grasp the cause, state and effect of a movement. They will be familiar with and able to apply models that describe friction between bodies and bodies in liquids and gases. - Students will be familiar with the terms torque and angular momentum and be able to use them for the dynamics of rotation. They will be familiar with and be able to explain the analogies and differences between translation and rotation. They will have learned how those principles can be transferred from the center of mass to rigid bodies. - Students will be familiar with the definitions for work, power and energy and know the different units for these dimensions. They will be familiar with the concept of conservative force and how it is used to define potential energy. - Students will be familiar with gravitational force as a fundamental interaction and be able to explain conclusions from it such as, for example, Kepler´s laws of planetary motion. - They will have mastered conservation of momentum, conservation of angular momentum and the conservation of energy as methods and be able to apply them to examples such as multidimensional collisions. - They will be familiar with the causes of gravitational pressure and buoyancy in liquids and gases and be able to explain the consequences thereof. Students will know which types of flow there are and how to record them. They will be able to describe and determine flows without turbulences using equations. - They will be familiar with temperature and heat quantity as basic parameters. They will be able to explain the principles and conclusions of the kinetic theory of gases. Students will know and be able to explain the main principles of thermodynamics and know and explain applications. - They will have gained insights and know where physical laws and methods are applied in everyday life, in technology and especially in sensors.

[*updated 08.01.2020*]

Module content:
Kinematics Definition of kinematic quantities for linear motion, Uniform linear motion, uniformly accelerated linear motion, free fall, Non-linear motions, in particular circular motion, non-horizontally launched projectiles, oscillations Dynamics of the mass point Force and momentum, conservation of momentum, especially elastic and inelastic collision, Newton´s laws of motion, Friction, Dynamics with curvilinear motion, especially circular motion, torque and angular momentum, conservation of angular momentum, Work, power, potential and kinetic energy, conservation of energy by conservative force, Gravitational force Dynamics of rigid bodies Center of gravity and moment of inertia of a rigid body, equations of rotational motion, physical pendulum, torsion pendulum, Rotational energy, gyroscope Mechanics of liquids and gases Gravitational pressure and buoyancy in liquids, Archimedes´ principle and Boyle´s law, Gravitational pressure and buoyancy in gases, in particular the atmosphere, laminar flow, in particular the continuity equation and Bernoulli´s principle, the Hagen-Poisuellle equation Turbulent flow, Reynolds number Thermodynamics Temperature as a concept, temperature measurement, heat capacity, Phase transitions, the kinetic theory of gases, the ideal gas law, the van der Waals equation, changes in states, Laws of thermodynamics, entropy, thermodynamic processes, heat engines, thermal conduction, laws of thermal radiation

[*updated 08.01.2020*]

Teaching methods/Media:
Board, lecture notes, presentations

[*updated 08.01.2020*]

Recommended or required reading:
Hering, Ekbert; Martin, Rolf; Stohrer, Martin: Physik für Ingenieure, Springer Vieweg, (latest edition) Hering, Ekbert; Martin, Rolf; Stohrer, Martin: Taschenbuch der Mathematik und Physik, Springer Vieweg Turtur, Claus Wilhelm: Prüfungstrainer Physik, Springer Spektrum

[*updated 08.01.2020*]

Power Electronics and Drive Systems Engineering

Module name (EN): Power Electronics and Drive Systems Engineering
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2505
Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)
ECTS credits: 5
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical exam with composition (3 lab experiments, ungraded)
Curricular relevance: EE1501 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 5, mandatory course E2505 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Stefan Winternheimer
Lecturer: Prof. Dr.-Ing. Stefan Winternheimer [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have acquired basic knowledge about electrical drive technology and the power electronics required for it. They will be able to distinguish between different electric drives and identify their areas of application. [*updated 08.01.2020*]

Module content:
1 DC drives 1.1 Direct current machines: basic design and operating characteristics 1.2 DC chopper converter: buck converter, boost converter, two- and four-quadrant chopper 2 Three-phase drives 2.1 Asynchronous machines: basic design and operating characteristics 2.2 Synchronous machines: basic design and operating characteristics 3. Analysis of actuating and motion processes 3.1 Quantities of the motion cycle 3.2 Forces and torques 3.3 Mechanical drive power 3.4 Power requirements of selected machines 4. Lab 4.1 AC power controller 4.2 Three-phase bridge connection 4.3 DC machine

[*updated 08.01.2020*]

Teaching methods/Media:
Transparencies, blackboard, lecture notes and electronic handouts

[*updated 08.01.2020*]

Recommended or required reading:
Fischer, Rolf: Elektrische Maschinen, Hanser, (latest edition) Mohan, Ned; Undeland, Tore M.; Robbins, William P.: Power Electronics, Wiley, (latest edition) Seefried, Eberhard: Elektrische Maschinen und Antriebstechnik, Vieweg, Braunschweig/Wiesbaden, 2001 Vogel, Johannes: Elektrische Antriebstechnik, Hüthig, Heidelberg, 1989, 4. Aufl.

[*updated 08.01.2020*]

Power Electronics and Drive Systems Engineering

Module name (EN): Power Electronics and Drive Systems Engineering
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2602
Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)
ECTS credits: 5
Semester: 6
Mandatory course: yes
Language of instruction: German
Assessment: Written exam, practical exam with composition (3 lab experiments, ungraded)
Curricular relevance: EE1601 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 6, mandatory course E2602 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Stefan Winternheimer
Lecturer: Prof. Dr.-Ing. Stefan Winternheimer [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have detailed knowledge about the operating behavior of DC machines and the control of DC drives. They will be able to convert a control problem into a block diagram, develop a functional control concept and design the required controllers independently. Students will have an overview of common inverter circuits and the necessary modulation methods. They will be able to develop the block diagram of a single-phase inverter. [*updated 08.01.2020*]

Module content:
1. DC drives 1.1 The DC machine as a controlled system 1.2 Fundamentals of control engineering 1.3 Speed-controlled DC machine 1.4 DC machine with variable excitation flux 2 Power inverter 2.1 The single-phase inverter 2.2 The three-phase inverter 2.3 The single-phase inverter as a controlled system 3 Lab 3.1 Speed-controlled DC machine 3.2 Asynchronous machine with frequency converter 3.3 Grid-connected PV system

[*updated 08.01.2020*]

Teaching methods/Media:
Transparencies, blackboard, lecture notes and electronic handouts

[*updated 08.01.2020*]

Recommended or required reading:
Leonhard, Werner: Control of Electrical Drives, Springer, Berlin, Heidelberg, 1990, Corr. 2. print Mohan, Ned; Undeland, Tore M.; Robbins, William P.: Power Electronics, Wiley, (latest edition) Riefenstahl, Ulrich: Elektrische Antriebstechnik, B.G. Teubner, (latest edition) Schröder, Dierk: Elektrische Antriebe - Regelung von Antriebssystemen, Springer, Berlin, Heidelberg, (latest edition)

[*updated 08.01.2020*]

Procedural Programming with C / C++

Module name (EN): Procedural Programming with C / C++

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2305

Hours per semester week / Teaching method: 4V+2U (6 hours per week)

ECTS credits: 7

Semester: 3

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
BMT2305.PRG Biomedical Engineering, Bachelor, ASPO 01.10.2018, semester 3, mandatory course
EE1302 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2018, semester 3, mandatory course
E2305 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 3, mandatory course

Workload:
90 class hours (= 67.5 clock hours) over a 15-week period.
The total student study time is 210 hours (equivalent to 7 ECTS credits).
There are therefore 142.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Reinhard Brocks

Lecturer: Prof. Dr. Reinhard Brocks

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to implement the concepts of procedural programming in the programming language C/C++. They will use design techniques to find solutions. They will use their knowledge about programming techniques to create well-structured and documented programs. They will use basic software development tools.

[*updated 08.01.2020*]

Module content:
- Procedural programming: fundamental data types, operators, control structures, functions, pointers and arrays, validity ranges and lifetime of objects, structures/unions, function pointers, command line arguments, references, namespaces - Design techniques: program flowchart - Programming techniques: modularization, separation of interface and implementation, callback functions, data structures and algorithms - Development tools: preprocessor, compiler, linker, shell, shell scripts, makefile, debugger

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Dausmann, Manfred: C als erste Programmiersprache, Springer Vieweg, (akt. Aufl.) Erlenkötter, Helmut: C Progammieren von Anfang an, rororo Erlenkötter, Helmut: C++: Objektorientiertes Programmieren von Anfang an, rororo, (akt. Aufl.) Kernighan, Brian W.; Ritchie, Dennis M.: Programmieren in C, Hanser, 1990, 2. Ausg. ANSI C Stroustrup, Bjarne: Die C++ Programmiersprache, Addison-Wesley, (akt. Aufl.) Wolf, Jürgen: C von A bis Z, Galileo Press, Bonn, 2009, 2. Aufl., ISBN 978-3-8362-1429-2

[*updated 08.01.2020*]

Process Automation

Module name (EN): Process Automation

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2503

Hours per semester week / Teaching method: 4PA (4 hours per week)

ECTS credits: 4

Semester: 5

Mandatory course: yes

Language of instruction:
German

Assessment:
Seminar presentation

Curricular relevance:
E2503 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 120 hours (equivalent to 4 ECTS credits).
There are therefore 75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Benedikt Faupel

Lecturer: Prof. Dr. Benedikt Faupel

[*updated 10.09.2018*]

Learning outcomes:
Within the framework of project work, solution strategies, suitable automation systems, tools and simulation tools for process automation problems will be specifically selected and prototypically implemented. Students will create their own solutions for sub-tasks that typically occur in the course of industrial automation projects. They will prepare and present their solutions didactically.

[*updated 08.01.2020*]

Module content:
1. Standards and guidelines for automation technology 2. Process identification methods 2.1. Analysis methods for identifying analog LTI systems 2.2. Least-squares method for identification of discrete LTI systems 3. Processing sensors/actuators in automation technology 3.1. Interfacing/information processing of sensors and actuators 3.2. Analog value processing with SPS (standardization) 3.3. How actuators function and operate 4. Automating sequence controls 4.1. Sequential function chart in control technology according to IEC 1131 4.2. Structure and function of recipe control 4.3. Realization of sequential programs for PLC with step chain programming and S7-Graph 5. Communication systems in automation technology 5.1. Serial communication 5.2. ISO/OSI layer model of communication 5.3. Fieldbus systems (Profibus, ProfiNet, ASI) 5.4. Networking PLC systems 6. Implementation of controllers on SPS 6.1. Designing control functions (two-point, three-point, PID controller) at function block level 6.2. Adaptation / integration of controller function blocks in practical applications

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, lab equipment, control engineering/process automation lab

[*updated 08.01.2020*]

Recommended or required reading:
Berger, Hans: Automatisieren mit SIMATIC S7-1500, Publicis MCD, 2017, 2. Aufl., ISBN 978-3-8957-8451-4 Grupp Frieder; Grupp Florian: MATLAB für Ingenieure, Oldenbourg, München, (latest edition) Schneider, Ekkehard: Methoden der Automatisierung, Vieweg, Braunschweig, 1999, ISBN 978-3528065669 Seitz, Matthias: Speicherprogrammierbare Steuerungen für die Fabrik- und Prozessautomation, Hanser, (latest edition) Wellenreuther, Günter; Zastrow, Dieter: Automatisieren mit SPS - Theorie und Praxis, Vieweg, Wiesbaden, (latest edition) Wellenreuther, Günter; Zastrow, Dieter: Automatisieren mit SPS - Übersichten und Übungsaufgaben, Vieweg, Wiesbaden, (latest edition)

[*updated 08.01.2020*]

Programming Microcontrollers

Module name (EN): Programming Microcontrollers

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2509

Hours per semester week / Teaching method: 4V (4 hours per week)

ECTS credits: 5

Semester: 5

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2509 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jürgen Schäfer

Lecturer: Prof. Dr.-Ing. Jürgen Schäfer

[*updated 10.09.2018*]

Learning outcomes:
Proficiencies: After successfully completing this module, students will be proficient in the following: structure of components of embedded systems, system-on-chip, special features of embedded system programming (cross-compiler, programming, debugging; GPIO, ADC, DAC, SPI, I2C, USART interfaces; interrupts and exceptions) Skills: Furthermore, students will be capable of working with a development tool for embedded systems, working with the documentation of a modern RISC microcontroller and configuring GPIOs, USART interfaces and timers, as well as creating interrupts and debugging embedded systems. Competencies: Students will also be able to program microcontroller-based embedded systems with limited resources under real-time conditions without an operating system. They will be able to implement simple hardware abstraction layers and realize simple controls using state machines. Students will be able to detect possible race conditions.

[*updated 08.01.2020*]

Module content:
1. Software development tools - Programming environment µVison (MDK-ARM) -- Project settings -- Compilers, linkers -- Debugging - Important support programs --TortoiseSVN -- Doxygen 2. Important design patterns 3- Concurrency - Problems - Possible solutions 4. Hardware abstraction layers (HAL) 5. Input and output - Abstract implementation of a communication interface based on an interface for receiving and sending data via an asynchronous (USART) and synchronous (SPI or I2C) serial interface. - Use of callback methods in connection with interrupts (inversion of control) - Time control via timer, PWM generation and analysis

[*updated 08.01.2020*]

Teaching methods/Media:
PC, blackboard, video projector, microcontroller evaluation boards

[*updated 08.01.2020*]

Recommended or required reading:
Douglass, B. P.: Design patterns for embedded systems in C, Elsevier Newnes, Amsterdam, 2011, ISBN 978-1-85617-707-8 Eißenlöffel, Thomas: Embedded-Software entwickeln: Grundlagen der Programmierung eingebetteter Systeme - Eine Einführung für Anwendungsentwickler, dpunkt.verlag, 2012, ISBN 978-3-89864-727-4 Hohl, William: ARM assembly language - fundamentals and techniques, CRC Press, 2009, ISBN 978-1-439-80610-4 Langbridge, James A.: Professional embedded ARM development, Wiliy, 2014, ISBN 978-1-118-78894-3 Lewis, Daniel W.: Fundamentals of embedded software with the ARM Cortex-M3, Pearson, Upper Saddle River, 2013, 2. Aufl., ISBN 978-0-13-335722-6 Yiu, J.: The Definite Guide to the ARM Cortex-M3, Newnes, Oxford, 2010, ISBN 978-1-85617-963-8

[*updated 08.01.2020*]

Programming Tools for Automation Solutions

Module name (EN): Programming Tools for Automation Solutions

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2412

Hours per semester week / Teaching method: 1V+1U (2 hours per week)

ECTS credits: 3

Semester: 4

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2412 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Benedikt Faupel

Lecturer:
Dipl.-Ing. (FH) Andreas Ehlen

[*updated 15.04.2020*]

Learning outcomes:
After successfully completing this course, students will be able to model and simulate the behavior and influencing variables in control loop structures and simple differential equations. Students will examine the time behavior of system arrangements and determine optimized controller parameters for classical control processes. They will be able to analyze the stability behavior of control loops and describe system properties of standard transmission systems via identification procedures.

[*updated 08.01.2020*]

Module content:
1. Introduction and the basics of Matlab/Simulink 2. Mathematical applications Structure of differential equations, modeling differential equations Output and processing of vectors and matrices Representing curves and simulation results 3. Simulation with Matlab/Simulink Designing controllers and analyzing control loops with MATLAB/SIMULINK Examining the influence and variation of control parameters (PID control, non-continuous controllers) Examining and modeling discrete control loops Controller design and layout for unstable and non-minimum phase systems
4. Process identification methods Analysis methods for determining a model for analog LTI systems Least-Square - Method for determining a model for discrete LTI systems

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, board, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Dorf, Richard C.; Bishop, Robert H.: Moderne Regelungssysteme, Pearson, 2006, 10. Aufl. Föllinger, Otto: Laplace- Fourier- und z-Transformation, VDE, (latest edition) Föllinger, Otto: Regelungstechnik, VDE, (latest edition) Grupp Frieder; Grupp Florian: MATLAB für Ingenieure, Oldenbourg, München, (latest edition) Lutz, Holder; Wendt, Wolfgang: Taschenbuch der Regelungstechnik, Harri Deutsch, (latest edition) Schulz, Gerd: Regelungstechnik, Oldenbourg, (latest edition) Unbehauen, Heinz: Regelungstechnik, Vieweg + Teubner, (latest edition)

[*updated 08.01.2020*]

Project Management

Module name (EN): Project Management

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2103

Hours per semester week / Teaching method: 2V+2U (4 hours per week)

ECTS credits: 5

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work (50%), Report (50%)

Curricular relevance:
E2103 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Stefan Winternheimer

Lecturer: Prof. Dr.-Ing. Stefan Winternheimer

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will have basic knowledge about project management. They will be able to apply systematic methods for problem solving, decision making and risk protection. Furthermore, they will be able to plan simple projects with the help of the MS-Project tool and estimate their effort and costs. Students will be prepared for later work in project teams.

[*updated 08.01.2020*]

Module content:
1 Principles of project management 2 Systematically analyzing problem causes 3 Systematically analyzing and evaluating decision alternatives 4 Identifying and mitigating risks during the course of a project 5 Planning a project 6 Estimating effort and costs 7 Cooperating in a project team

[*updated 08.01.2020*]

Teaching methods/Media:
Transparencies, blackboard, PC, video projector, lecture notes and electronic handouts with exercises

[*updated 08.01.2020*]

Recommended or required reading:
Burghardt, Manfred: Einführung in Projektmanagement, Publicis MCD, Erlangen Seibert, Siegfried: Technisches Management, B.G. Teubner, Stuttgart, Leipzig, 1998

[*updated 08.01.2020*]

Project Work

Module name (EN): Project Work

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2614

Hours per semester week / Teaching method: -

ECTS credits: 5

Semester: 6

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
E2614 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course

Workload:
The total student study time for this course is 150 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
N.N.

Lecturer: N.N.

[*updated 10.09.2018*]

Learning outcomes:
In their projects, students will work independently on a clearly defined task within a specified time frame. After successfully completing this course, students will be able to carry out, document and present a practice-relevant project in compliance with budget constraints, deadlines and best practices.

[*updated 08.01.2020*]

Module content:
During the course, students will work independently on a clearly defined project from their respective area of specialization. They will document the scope and content of their project in the form of a specification sheet. The project will be supervised by specialists from the respective subject areas. Work will be carried out in the htw labs. Results will be documented in a project documentation. The results of the project work will be presented and discussed within the framework of a presentation.

[*updated 08.01.2020*]

Teaching methods/Media:
Project-dependent

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Signal and Image Processing

Module name (EN): Signal and Image Processing
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2504
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 5
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2504 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Dietmar Brück
Lecturer: Prof. Dr.-Ing. Dietmar Brück [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will be able to apply system theory to image processing problems. They will have acquired the skills and abilities necessary for designing and implementing image processing systems. They will be familiar with the hard and software used for image processing and be able to convert it into systems. Students will be able to independently understand a task from the field of optical quality assurance in the broadest sense, find solutions and put these solutions into action. Our primary focus will be on the application of these skills. Students will be able to adapt known solutions to new tasks and come up with new combinations of methods. [*updated 08.01.2020*]

Module content:
1. One-dimensional signals in the time domain, mathematical description, representation of associated spectra, explanation of filter process, transition to discrete signals and discrete spectra, sampling, FFT 2. Two-dimensional signals, extending mathematical theory 3. Images as two-dimensional signals in the spatial domain, simple key figures for images, quantization and rasterization of images, discrete image processing algorithms in the spatial domain 4. Image processing algorithms in the frequency domain

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Gonzalez, Rafael C.; Woods, Richard E.: Digital Image Processing, Pearson, (latest edition) Pratt, W.K.: Digital Image Processing, Wiley, 1991, 2nd Ed. Rosenfeld, Azriel; Kak, Avinash C.: Digital Picture Processing, Vol. 1+2, Academic Press Wahl, Friedrich M.: Digitale Bildsignalverarbeitung, Springer, 1989

[*updated 08.01.2020*]

Signal and Systems Theory

Module name (EN): Signal and Systems Theory
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2405
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 5
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: BMT.E2405 Biomedical Engineering, Bachelor, ASPO 01.10.2018, semester 4, mandatory course E2405 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martin Buchholz
Lecturer: Prof. Dr. Martin Buchholz [*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to grasp the abstract, system-theoretical relationships necessary for understanding how signals are transmitted in telecommunications systems. - They will be able to classify signals and systems and analyze properties such as linearity, time invariance, causality or stability. - They will be familiar with the procedure of folding for calculating systems in the time domain and be able to apply it to various examples. - Students will be able to explain the relationship between impulse response and frequency response. - They will be able to apply the Fourier transform to analyze signal processing systems in the frequency domain. - Students will be able to describe the relationships between Fourier and Laplace transforms and apply these transforms to IT systems. - They will be able to use the Laplace transform to calculate control systems in information technology (synchronization loops, amplifier control, adaptive filters). - Students will be able to calculate and outline the influences on signals and systems that arise when scanning to digitize signals. - They will understand the necessity of describing signals and systems with the complex baseband representation. - Students will have acquired the basics necessary for analog and digital signal processing, image processing, spectral analysis and communication technology.

[*updated 08.01.2020*]

Module content:
Our focus will be on system theoretical knowledge for the field of information technology 1. Introduction, signals and systems, terminology and definitions 2. Signal classification 3. Describing LTI systems in the time domain 4. Describing LTI systems in the frequency domain 5. Describing LTI systems using the Laplace transform 6. Discrete-time signals and systems 7. Representing complex signals

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, projector, MATLAB-SIMULINK, exercise sheets

[*updated 08.01.2020*]

Recommended or required reading:
Frey, Thomas; Bossert, Martin: Signal- und Systemtheorie, Vieweg + Teubner, (latest edition) Girod, Bernd; Rabenstein, Rudolf; Stenger, Alexander: Einführung in die Systemtheorie, Teubner, (latest edition) Lüke, Hans-Dieter; Ohm, Jens-Rainer: Signalübertragung - Grundlagen der digitalen und analogen Nachrichtenübertragungssysteme, Springer, (latest edition) Oppenheim, Alan V.; Willsky, Alan S.: Signale und Systeme: Lehrbuch, Wiley-VCH, 1991, 2. Aufl., ISBN 978-3527284337 Scheithauer, Rainer: Signale und Systeme, Teubner, 2005, 2. Aufl. Werner, Martin: Signale und Systeme: Lehr- und Arbeitsbuch mit MATLAB-ßbungen, Vieweg, 2005, 2. Aufl.

[*updated 08.01.2020*]

Smart Grids and Distributed Generation

Module name (EN): Smart Grids and Distributed Generation
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2410
Hours per semester week / Teaching method: 2V+2P (4 hours per week)
ECTS credits: 5
Semester: 4
Mandatory course: yes
Language of instruction: German
Assessment: Project work
Curricular relevance: E2410 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Michael Igel
Lecturer: Prof. Dr. Michael Igel [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have initial experience in working with typical simulation tools in electrical power engineering. They will be able to solve and validate simple problems with the help of these tools. In addition, they will be capable of operating and evaluating common data acquisition and output devices. [*updated 08.01.2020*]
Module content: 1. Introduction to a network calculation tool 2. Load flow calculations in power grids with distributed generation plants 3. Simulation of power electronic systems 4. Model design for smart grid components 5. Validating simulation results 6. Acquisition and output of alternating quantities with the help of suitable tools 7. Economic consideration of distributed generation plants [*updated 08.01.2020*]

Teaching methods/Media: Overhead slides, blackboard, lecture notes and exercise sheets in electronic form, presentation, video projector, engineering tools [*updated 08.01.2020*]
Recommended or required reading: Bosl, Angelika: Einführung in MATLAB/Simulink, Hanser, (latest edition) [*updated 08.01.2020*]

System Theory and Control Engineering 1

Module name (EN): System Theory and Control Engineering 1

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2402

Hours per semester week / Teaching method: 2V+2U (4 hours per week)

ECTS credits: 5

Semester: 4

Mandatory course: yes

Language of instruction:
German

Assessment:
Written composition (ungraded)

Curricular relevance:
E2402 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course
MST2.SYS1 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2019, semester 4, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Benedikt Faupel

Lecturer: Prof. Dr. Benedikt Faupel

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to describe and apply basic concepts and mathematical methods for the evaluation of fundamental transmission systems. They will be able to analyze the time and frequency behavior of continuous transmission systems and extend these to control loop structures. Students will be able to determine the influence of varying controller parameters on the time response in control loops and evaluate it using case studies with simulation models.

[*updated 08.01.2020*]

Module content:
1. Introduction to system theory: Definitions / Standards and nomenclature / LTI systems / SISO systems / MIMO systems / Signal flow diagrams 2. Applying the Laplace transform and calculation rules 3. Elementary transfer elements: Differential equation and transfer function / Pole-zero distribution / Locus and Bode diagrams / Time response in form (impulse and step response) 4. Standard transmission elements (P, I, D, PT1, PT2, PTn, IT1, IT2, ITn, DT1, DT2, dead-time element, all-pass element, lead-lag element) 5. Control loop structures: Open control loop / Reference and disturbance transfer behavior / Time behavior in the control loop 6. Stability: Definition of stability / Algebraic stability criteria (Hurwitz and Routh criteria) / Simplified Nyquist criterion in the locus and in the soil diagram 7. Static and dynamic behavior of control loop structures: Description of control loop elements / reference and disturbance behavior / 2nd order systems / Steady-state accuracy / Variation of control parameters 8. Technical application examples and their simulation with Matlab/Simulink: Creating block diagrams / Setting up and solving differential equations / Determining time behavior

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Braun, Anton: Grundlagen der Regelungstechnik, Hanser, 2005 Dorf, Richard C.; Bishop, Robert H.: Moderne Regelungssysteme, Pearson, 2006, 10. Aufl. Föllinger, Otto: Laplace- Fourier- und z-Transformation, VDE, (latest edition) Föllinger, Otto: Regelungstechnik, VDE, (latest edition) Lutz, Holder; Wendt, Wolfgang: Taschenbuch der Regelungstechnik, Harri Deutsch, (latest edition) Schulz, Gerd: Regelungstechnik, Oldenbourg, (latest edition) Unbehauen, Heinz: Regelungstechnik, Vieweg + Teubner, (latest edition)

[*updated 08.01.2020*]

System Theory and Control Engineering 2

Module name (EN): System Theory and Control Engineering 2

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2502

Hours per semester week / Teaching method: 2V+2U (4 hours per week)

ECTS credits: 5

Semester: 5

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2502 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Benedikt Faupel

Lecturer: Prof. Dr. Benedikt Faupel

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be familiar with the subject-specific terminology of continuous control loop structures and be capable of analyzing the behavior and influencing variables in control loop structures in both the time and frequency domains. They will be able to classify different controller types and design technical components for their implementation. Based on standard setting procedures, they will be able to implement control loop quality requirements for the design of control parameters that they adapt and optimize using simulation models and case studies.

[*updated 08.01.2020*]

Module content:
1. Basics of control engineering 1.1. Control system elements and functional diagrams 1.2. Definitions, standards and nomenclature, difference between regulation/control 1.3. Practical tasks of control engineering in process plants 2. Static and dynamic behavior of control loops 2.1. Response to set point changes and disturbances 2.2. Determining the steady-state deviation for different input signal characteristics 3. Designing, tuning and optimizing controllers in the time domain 3.1. Tuning control loops to a defined damping 3.2. Tuning control loops according to Ziegler-Nicols, / Chiens, Hrones, Reswick 3.3. Tuning according to the T-sum rule 3.4. Tuning according to the modulus optimum and the symmetric optimum 4. Designing, tuning and optimizing according to the frequency response characteristic method 4.2. Tuning according to phase and gain margin 4.3. Tuning controller parameters in a Bode plot 5. Discontinuous controllers (two- and three-position controllers) 5.1. Time behavior 5.2. Optimizing and tuning discontinuous controllers 6. Applications control loop behavior and controller design with MATLAB/SIMULINK 7. Example implementation of software controllers on PLC systems

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, lecture notes

[*updated 08.01.2020*]

Recommended or required reading:
Dorf, Richard C.; Bishop, Robert H.: Moderne Regelungssysteme, Pearson, 2006, 10. Aufl. Föllinger, Otto: Laplace- Fourier- und z-Transformation, VDE, (latest edition) Föllinger, Otto: Regelungstechnik, VDE, (latest edition) Grupp Frieder; Grupp Florian: MATLAB für Ingenieure, Oldenbourg, München, (latest edition) Lutz, Holder; Wendt, Wolfgang: Taschenbuch der Regelungstechnik, Harri Deutsch, (latest edition) Schulz, Gerd: Regelungstechnik, Oldenbourg, (latest edition) Unbehauen, Heinz: Regelungstechnik, Vieweg + Teubner, (latest edition)

[*updated 08.01.2020*]

Technical English for Electrical Engineers and Professional Presentations

Module name (EN): Technical English for Electrical Engineers and Professional Presentations
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2508
Hours per semester week / Teaching method: 1V+1U (2 hours per week)
ECTS credits: 2
Semester: 5
Mandatory course: yes
Language of instruction: German
Assessment: Written exam
Curricular relevance: E2508 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Christine Sick
Lecturer: Miriam Wedig, M.A. (lecture) [*updated 18.07.2019*]

Learning outcomes:
The three English modules are to be seen in conjunction with one another. They provide students with a framework in which to develop their job-related English language skills in from the entry level B1 to level B2. This module focuses on the technical language relevant to electrical engineers for technical descriptions and lectures. After successfully completing this course, students will be able to follow subject-specific lectures, presentations or lectures in English and organize lecture content in notes. Students will be familiar with various reading strategies and will be able to apply them to course-specific, technical texts. Students will be familiar with the strategies for creating professional, subject-specific presentations in English. They will be able to structure an English-language presentation and use typical means of speech for its linguistic implementation. This will help them continue to develop their understanding of functional language use. Students will also be able to describe technical objects and systems and their functionality outside of the classroom situation.

[*updated 08.01.2020*]

Module content:
Technical English: - General and detailed comprehension of course-specific technical texts and lectures - Note-taking techniques - Technical data - Describing technical systems and their functionality (e.g. a hydropower plant) - Cause and effect relationships Presentations: - Strategic knowledge - Structure of a presentation in English - Useful phrases - Describing tools, figures, cause-effect relationships and trends - Preparing a short technical lecture and presenting it to other course participants In addition: - Vocabulary - Repetition of the relevant grammatical structures

[*updated 08.01.2020*]

Teaching methods/Media:
Teaching and learning materials (print, audio, video), multimedia teaching and learning software for specific target groups

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Telecommunication Systems

Module name (EN): Telecommunication Systems

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2406

Hours per semester week / Teaching method: 3P+2S (5 hours per week)

ECTS credits: 6

Semester: 4

Mandatory course: yes

Language of instruction:
German

Assessment:
Practical test with term paper (60%), seminar presentation (40%)

Curricular relevance:
E2406 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 4, mandatory course

Workload:
75 class hours (= 56.25 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 123.75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Albrecht Kunz

Lecturer: Prof. Dr. Albrecht Kunz

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this module, students will possess comprehensive system knowledge in the field of communications engineering and thus, be able to advance innovative developments in their future careers. They will understand the techniques for setting up a cellular mobile network. They will be able to distinguish between different system generations in mobile communications and explain their common features. Students will be able to familiarize themselves with and apply various radio standards (Bluetooth, WLAN, etc.). They will be familiar with the principles of satellite navigation and be able to use this technique to develop a mobile navigation device that receives data from global navigation satellite systems and compares it with target coordinates. Students will be familiar with the possibilities of single board computers and will be able to use their programming skills to solve practical tasks in the lab class. With the knowledge acquired in the seminar and the lab class, students will be able to set up and operate a wireless communication channel. Lab tasks will be assigned to small teams. Within the teams, students must work together to solve practical tasks. They will use lab equipment to plan and carry out measurements. During the seminar, students must present the results of their group work in a well-structured, understandable and appealing manner, in order to inform their fellow students about the topics dealt with in the seminar/lab class. Students must write a technical "report" with a clear structure, appealing layout and concise wording.

[*updated 08.01.2020*]

Module content:
Telecommunications Seminar 1. Analog and digital modulation methods 2. Transmitting digital signals in the baseband 3. Multiple access method 4. Mobile radio systems (GSM, UMTS, LTE, 5G) 5. Radio standards for the close range (e.g. Bluetooth, WLAN) 6. Global navigation satellite systems (GNSS) 7. Satellite communication lab class 8. Structure and function of single board computers 9. Applications for controlling simple functions, e.g. controlling LEDs and transistors as switches 10. Storing data on external media (e.g. EEPROM or SD card) 11. Data exchange via infrared interface, TFT/OLED displays 12. Creating a Bluetooth transmission path, storing the data received on an SD card, transmitting data to a PC 13. Creating a WLAN transmission path, storing the data received on an SD card, transmitting data to a PC 14. Constructing a mobile battery-operated transmitter unit: using a GPS sensor, reading GPS data, displaying and transmitting GPS data via a radio transmission link (Bluetooth / WLAN) to a receiving station, displaying the data on a display. 15. Geocaching, importing GPS target data and comparing it with the actual GPS position

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation with blackboard and projector during the seminar, use of telecommunication equipment in the lab (signal generator, oscilloscope, single board computer, radio modules, GPS modules)

[*updated 08.01.2020*]

Recommended or required reading:
Bauer, Manfred: Vermessung und Ortung mit Satelliten , Wichmann, (latest edition) Benkner, Thorsten: Grundlagen des Mobilfunks, Schlembach, 2007, 1. Aufl., ISBN 978-3935340441 Bonacina, Michael: Arduino Handbuch für Einsteiger, CreateSpace Independent Publishing Platform, 2017, 1. Aufl., ISBN 978-1544255491 Dahlman, Eric; Parkvall, Stefan; Skold, Johan: 4G, LTE-Advanced Pro and the Road to 5G, Academic Press, 2016, ISBN 978-0128045756 Freyer, Ulrich: Nachrichtenübertragungstechnik, Hanser, (latest edition) Gessler, Ralf; Krause, Thomas: Wireless-Netzwerke für den Nahbereich, Vieweg + Teubner, (latest edition) Kofler, Michael; Kühnast, Charly; Scherbeck, Christoph: Raspberry Pi: das umfassende Handbuch, Rheinwerk Technik, (latest edition) Korhonen, Juha: Introduction to 3G mobile communications, Artech House, 2003 Lüke, Hans-Dieter; Ohm, Jens-Rainer: Signalübertragung - Grundlagen der digitalen und analogen Nachrichtenübertragungssysteme, Springer, (latest edition) Mansfeld, Werner: Satellitenortung und Navigation, Vieweg + Teubner, (latest edition) Unbehauen, Heinz: Regelungstechnik, Vieweg + Teubner, (latest edition) Sauter, Martin: Grundkurs Mobile Kommunikationssysteme, Springer Vieweg, (latest edition) Werner, Martin: Nachrichtentechnik, Vieweg, (latest edition)

[*updated 08.01.2020*]

Telecommunications Technology Lab Course

Module name (EN): Telecommunications Technology Lab Course

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2612

Hours per semester week / Teaching method: 1V+4P (5 hours per week)

ECTS credits: 6

Semester: 6

Mandatory course: yes

Language of instruction:
German

Assessment:
Practical exam with a short paper

Curricular relevance:
E2612 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 6, mandatory course

Workload:
75 class hours (= 56.25 clock hours) over a 15-week period.
The total student study time is 180 hours (equivalent to 6 ECTS credits).
There are therefore 123.75 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer: Prof. Dr. Martin Buchholz

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this combination lecture/lab course, students will - have in-depth knowledge about high-frequency engineering and high-frequency measurement technology. - be able to calculate complex analogue and digital transmission systems and to verify them metrologically. - be able to simulate antennas and characterize them metrologically. - be able to perform independent measurements with a spectrum analyzer and a network analyzer. - be able to perform measurements on optical communication systems. - be able to plan RFs. - be able to use modern development tools to implement digital algorithms in an FPGA.

[*updated 08.01.2020*]

Module content:
Lecture topics: 1. Noise figure and sensitivity of an HF receiver 2. Linear and non-linear signal distortion 3. Receiver architectures and high frequency components Lab experiments: 1. Interferometry: measuring a glass fiber using an optical interferometer 2. Eye diagram: evaluating an eye diagram on a 2.5 Gbit/s transmission 3. Spectrum analyzer: measuring the spectra of modulated signals 4. Network analyzer 1: measuring the S-parameters of passive components 5. Network analyzer 2: measuring the S-parameters of active HF components 6. Simulating HF components and systems with EDA software 7. Antenna test: measuring the 3-dimensional antenna pattern 8. Image processing: applying various filter operators 9. Wave propagation: using a planning tool for the optimization of digital radio systems 10. Implementing digital algorithms from receiver technology in hardware

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes, projector, laboratory

[*updated 08.01.2020*]

Recommended or required reading:
Hiebel, Michael: Grundlagen der vektoriellen Netzwerkanalyse, Rohde & Schwarz, 2006 Pehl, Erich: Digitale und analoge Nachrichtenübertragung, Hüthig, 2001, 2. Aufl. Rauscher, Christoph; Janssen, Volker; Minihold, Roland: Grundlagen der Spektrumanalyse, Rohde & Schwarz, 2007 Razavi, Behzad: RF Microelectronics, Prentice Hall, (latest edition) Thumm, Manfred K.A.; Wiesbeck, Werner; Kern, Stefan:: Hochfrequenzmesstechnik - Verfahren und Messsysteme, Teubner, 1998, 2. Aufl.

[*updated 08.01.2020*]

Work Experience Phase

Module name (EN): Work Experience Phase
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2701
Hours per semester week / Teaching method: -
ECTS credits: 14
Semester: 7
Mandatory course: yes
Language of instruction: German
Assessment: Seminar presentation (ungraded), written composition (ungraded)
Curricular relevance: E2701 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 7, mandatory course
Workload: The total student study time for this course is 420 hours.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Dozenten des Studiengangs
Lecturer: Dozenten des Studiengangs [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have acquired practical experience from a real working environment in the field of their intended degree. They will have applied the theoretical knowledge acquired during their studies to typical engineering fields of work by successfully solving tasks. [*updated 08.01.2020*]
Module content: Students will get to know the areas of work for graduates and engineers in their respective company during their 3-month work experience phase. They will take on tasks and, increasingly, work independently using their acquired skills and knowledge. The focus is on the practical application of acquired skills and knowledge. [*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Electrical Engineering and Information Technology Bachelor - optional courses

Applications in Telecommunications

Module name (EN): Applications in Telecommunications

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2570

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 3

Semester: 5

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2570 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer: Prof. Dr. Martin Buchholz

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this course, students will be able to understand the connection between theoretical knowledge and practical application. In this course, students will be made familiar with the practical uses of various telecommunications technologies. A selection of technologies used in practice, ranging from wired transmission technology (xDSL) and near-field radio applications (RFID, near-field communications, etc.) to bidirectional satellite radio systems (DVB-RCS), will be presented and combined with the basic knowledge already acquired BY students during their studies. The targeted inclusion of exercises from different areas of system implementation will help students approach the development and application of new technologies with confidence. In addition to the technological requirements for implementing a telecommunications application, the special features of the application itself and the relevant standardization work will also be highlighted. Student will be able to identify connections between the goal of the application, its technological characteristics and the interests of the participants involved in the application´s implementation.

[*updated 08.01.2020*]

Module content:
Basic concepts, DSL, Digital Subscriber Line, RFID technology, RFID characteristics, RFID applications, ePassport, near-field communications, SmartCards, satellite radio, DVB-RCS, synchronization, norms and standards, interface descriptions, spectral compatibility on cables, initialization of communication links, protocols, protocol errors, error analysis, basic cryptographic methods

[*updated 08.01.2020*]

Teaching methods/Media:
PC, projector, blackboard

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

French for Beginners II

Module name (EN): French for Beginners II

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2423

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 2

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written examination (final exam)

Curricular relevance:
E2423 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, optional course, non-technical
KI660 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2014, semester 6, optional course, non-technical
KIB-FFA2 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2017, semester 6, optional course, non-technical
MAB.4.2.1.7 Mechanical and Process Engineering, Bachelor, ASPO 01.10.2013, semester 6, optional course
MST.FA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2012, semester 6, optional course, non-technical
MST.FA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2019, semester 6, optional course, non-technical
PIBWN41 Applied Informatics, Bachelor, ASPO 01.10.2011, semester 6, optional course, not informatics specific
PIB-FFA2 Applied Informatics, Bachelor, ASPO 01.10.2017, semester 6, optional course, not informatics specific
MST.FA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2011, semester 6, optional course, non-technical

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Christine Sick

Lecturer: Prof. Dr. Christine Sick

[*updated 31.03.2020*]

Learning outcomes:
The courses French for Beginners I and II are based on each other. In the course of the two modules, students will first reach proficiency level A1 and then advance to level A2 of the European Framework of Reference for Languages. The goal of the course is to provide students with basic knowledge of the French language, which will enable them to communicate in general and professional situations as quickly as possible, both orally and in writing.

To do so, all four skills (speaking, listening comprehension, reading and writing) will be trained equally. Content development will be supported by the repetition of the relevant grammatical structures. The course takes a communicative and pragmatic approach that particularly promotes communicative competence in job-relevant situations through the use of role playing and situational dialogues.

This also includes intercultural aspects that raise the students´ awareness of cultural differences and enable them to assert themselves in specific situations.

[*updated 26.02.2018*]

Module content:
Job profiles and the workplace
- Addresses and telephone numbers
- Work routine: working hours, breaks
- Internal communication: giving information
- Accepting and rejecting suggestions
- Invitations and business lunches
- Business trips

Telephone communication
- Asking for and giving information
- Spelling things
- Making reservations
- Making appointments with date and time

Directions
- Asking for directions
- Giving directions
- Location details

In addition, we will concentrate on basic grammatical structures. Students should work on and expand their basic vocabulary independently.

[*updated 26.02.2018*]

Recommended or required reading:
The course is based on the following textbook and will be supplemented by suitable material from other textbooks:

Jambon, Krystelle: Voyages 1 - Französisch für Erwachsene, Klett, Stuttgart: 2006.

We also recommend purchasing the following grammar exercise book: Eurocentres Paris (group of authors): Exercices de grammaire en contexte - niveau débutant, Hachette Livre, Paris: 2000, 144 p.

Students will receive a list of recommended teaching and learning materials.

We recommend the following multimedia learning program for independent learning: Oberstufe Französisch. 6000 Vokabeln zu allen Themen. Vokabellernprogramm auf CD-ROM mit Sprachausgabe. Klett-Verlag, Stuttgart

[*updated 26.02.2018*]

Fundamentals of Programming Using NI LabVIEW

Module name (EN): Fundamentals of Programming Using NI LabVIEW

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2531

Hours per semester week / Teaching method: 1V+1U (2 hours per week)

ECTS credits: 2

Semester: 5

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam

Curricular relevance:
E2531 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Bernd Valeske

Lecturer: Prof. Dr.-Ing. Bernd Valeske

[*updated 10.09.2018*]

Learning outcomes:
1. Analyzing the basic properties of LabVIEW for data-flow processing 2. How to confidently manage an existing development environment 3. Mapping loops and structures 4. Abstracting modular code design 5. Dealing with errors, troubleshooting and error handling 6. Creating and visualizing clearly structured GUIs 7. Adapting common design patterns and methods such as state machines or producer-consumer architectures 8. Demonstrating the parallelization of independent program algorithms 9. The NI LabVIEW Academy offers students the opportunity to obtain a free LabVIEW-certified Associate Developer certification (valid for 2 years) at the HTW.

[*updated 08.01.2020*]

Module content:
1. Components of a LabVIEW program 2. What the development environment can do 3. Documentation 4. Data types 5. Data flow and troubleshooting 6. Loops and structures 7. Merging data 8. Programming techniques and methods 9. Communication between parallel loops 10. Improving code 11. Controlling the UI 12. Working in projects 13. Practical applications through exercises and project work

[*updated 08.01.2020*]

Teaching methods/Media:
Presentation, blackboard, course material from National Instrument

[*updated 08.01.2020*]

Recommended or required reading:
Mütterlein, Bernward: Handbuch für die Programmierung mit LabVIEW, Spektrum, 2009, ISBN 978-3-8274-2337-5

[*updated 08.01.2020*]

Introduction to Wireless LANs

Module name (EN): Introduction to Wireless LANs

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2428

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 3

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam (90 min.)

Curricular relevance:
E2428 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, optional course, technical
KI632 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2014, semester 6, optional course, technical
KIB-WLAN Computer Science and Communication Systems, Bachelor, ASPO 01.10.2017, semester 6, optional course, technical
PIBWI20 Applied Informatics, Bachelor, ASPO 01.10.2011, semester 6, optional course, informatics specific
PIB-WLAN Applied Informatics, Bachelor, ASPO 01.10.2017, semester 6, optional course, informatics specific

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Dipl.-Math. Wolfgang Braun

Lecturer: Dipl.-Math. Wolfgang Braun

[*updated 02.04.2020*]

Learning outcomes:
After successfully completing this module, students will have a basic understanding of the terms and relationships required for the use of WLAN in communications technology.
- They will be able to explain the basic concepts of WLAN technologies according to the standard 802.11
- They will be able to use the formulas from telecommunications engineering discussed in the lecture to solve problems in the field of WLAN.
- Students will know how to set up secure WLAN environments
- They will be able to explain basic procedures for planning, installing, configuring (functionality, security) and monitoring WLAN systems
- And they will be able to design simple WLAN applications

[*updated 19.02.2018*]

Module content:
- Basic functionality according to the IEEE 802.11 standard
- Typical areas of application and reasons for use
- Basic knowledge about electromagnetic waves (modulation, attenuation, antenna gain, free space path loss,...)
- Practical exercises on the propagation of electromagnetic waves
- Problems with use and negative aspects
- The technologies of the WLAN standard 802.11
- Presentation of a current system with practical experiments
- Security in WLANs
- Planning and monitoring WLANs with a presentation of the software used for this purpose
- Examples of use
- Evaluation criteria for WLAN systems

[*updated 19.02.2018*]

Teaching methods/Media:
Lecture using PowerPoint slides and worksheets. Practical experiments with standard WLAN hardware and home-made antennas.

[*updated 19.02.2018*]

Recommended or required reading:
PowerPoint slides will be available to the students.
Rech, J. : Wireless LANs Heise-Verlag, 4. Auflage, Hannover 2012, ISBN 978-3-936931-75-4
Kauffels, F.-J. : Moderne Wireless-Technologien, Technologiereport der Firma ComConsult, 2012

[*updated 19.02.2018*]

Methods and Applications of Artificial Intelligence for Signal and Image Processing

Module name (EN): Methods and Applications of Artificial Intelligence for Signal and Image Processing
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2542
Hours per semester week / Teaching method: 4PA (4 hours per week)
ECTS credits: 8
Semester: 5
Mandatory course: no
Language of instruction: German
Assessment: Term paper (25%), seminar presentation (75%)
Curricular relevance: E2542 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 240 hours (equivalent to 8 ECTS credits). There are therefore 195 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Ahmad Osman
Lecturer: Prof. Dr.-Ing. Ahmad Osman [*updated 10.09.2018*]
Learning outcomes: After successfully completing this course, students will have learned and be able to apply the practical and scientific methods of project work to the creation of a term paper based on examples, typical problems and applications from the field of signal and image processing with AI, for example research on the state of the art in image processing, classification methods, regression methods, data compression, data reconstruction, human-machine interaction, literature research (also English technical literature), presentation of project results. Students will be expected to document and explain their approach. They must justify and present their results on the basis of engineering research and and knowledge. Their subsequent presentation must succinctly explain/summarize these aspects and illustrate the use of methods for their project work. [*updated 08.01.2020*]

Module content:
Image processing: filtering techniques Image segmentation: region-based or contour-based techniques Classification methods: neural networks, support vector machine etc. Data fusion: the Dempster-Shafer Theory Data reconstruction Data visualization Data compression Human-machine interaction Research to deepen technical or scientific aspects in the form of a supervised term paper. Literature research (also in English) Scientific presentations

[*updated 08.01.2020*]

Teaching methods/Media:
Term paper with academic supervision in a defined area of specialization or topic using the methods of scientific project work. Participants must be familiar with the state-of-the-art of research/technology in selected areas of AI and be able to critically examine research projects.

[*updated 08.01.2020*]

Recommended or required reading:
Luger, George F.: Artificial Intelligence, Addison-Wesley, 2009, ISBN 978-0-13-209001-8 Mitchell, Tom M.: Machine learning, McGraw-Hill, 1997, ISBN 978-0-07-042807-2 Russell, Stuart J.; Norvig, Peter: Artificial intelligence: a modern approach, Pearson, 2009, 3rd Ed., ISBN 978-0-13-207148-2

[*updated 08.01.2020*]

Oral and General Presentation Skills in the Engineering Sciences

Module name (EN): Oral and General Presentation Skills in the Engineering Sciences
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2581
Hours per semester week / Teaching method: 1V+1U (2 hours per week)
ECTS credits: 2
Semester: 5
Mandatory course: no
Language of instruction: German
Assessment: Seminar presentation
Curricular relevance: E2581 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course MAB.4.2.1.31 Mechanical and Process Engineering, Bachelor, ASPO 01.10.2013, optional course, general subject MAB_19_.4.2.1.31 Mechanical and Process Engineering, Bachelor, ASPO 01.10.2019, optional course, general subject MAM.2.1.1.19 Engineering and Management, Master, ASPO 01.10.2013, optional course, general subject
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Dr. Peter Ludwig
Lecturer: Dr. Peter Ludwig [*updated 10.09.2018*]

Learning outcomes:
Within the course of this module, students will be introduced to the basics of rhetoric and presentation techniques for technical professions and individually coached on verbal and non-verbal communication. The course is practice and training-oriented. In terms of methodology, it offers a mixture of lectures, individual and team work, as well as targeted individual training for its participants. Students will expand, deepen and consolidate the following skills: - Finding/strengthening one´s own communication ductus - Structuring and coordinating information - Developing/strengthening one´s own rhetorical skills - Assessing communication partners and situations - Giving and taking feedback - Effective use of presentation techniques

[*updated 08.01.2020*]

Module content:
1. Basics of rhetoric and presentation 2. Planning a presentation (organization/checklist) 3. Content concept (ordering/structuring information) 4. Rhetorical practice (stylistic devices/argumentation strategies) 5. Visualization concept (working with media, designing slides) 6. Sequence (structure, individual phases and their structure) 7. Individual training (improving verbal and non-verbal communication) 8. Incident management (dealing with interruptions and conflicts)

[*updated 08.01.2020*]

Teaching methods/Media:
Board, overhead projector, beamer, exercises and training units (with video recording)

[*updated 08.01.2020*]

Recommended or required reading:
Fey, Heinrich: Sicher und überzeugend präsentieren, Walhalla, 1996 Lackner, Tatjana; Hollenstein, Ronny; Lentsch, Josef: Die Schule des Sprechens. Rhetorik und Kommunikationstraining, ßbv & hpt, 2000 Schulz von Thun, Friedemann; Ruppel, Johannes; Stratmann, Roswitha: Miteinander reden. Kommunikationspsychologie für Führungskräfte, Rowohlt, 2003

[*updated 08.01.2020*]

Problem Solving Technology and Decision Making

Module name (EN): Problem Solving Technology and Decision Making
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2583
Hours per semester week / Teaching method: 1V+1U (2 hours per week)
ECTS credits: 2
Semester: 5
Mandatory course: no
Language of instruction: German
Assessment: Oral examination (50%), project work (50%)
Curricular relevance: E2583 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Stefan Winternheimer
Lecturer: Prof. Dr.-Ing. Stefan Winternheimer [*updated 18.07.2019*]
Learning outcomes: After successfully completing this course, students will have gained insight into how engineers work. They will be trained and confident in the application of systematic methods for problem solving, decision making and risk protection. By implementing these methods in small groups, students will be prepared to work successfully in project teams. [*updated 08.01.2020*]

Module content:
1. Principles of project management 2. Systematic analysis of problem causes 3. Systematic analysis and evaluation of decision alternatives 4. Identifying and safeguarding against risks during a project 5. Project teamwork

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture and tutorial (block seminar possible); lecture notes, transparencies; blackboard; PC; video projector

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Russian for Beginners 2

Module name (EN): Russian for Beginners 2
Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018
Module code: E2427
Hours per semester week / Teaching method: 2SU (2 hours per week)
ECTS credits: 2
Semester: according to optional course list
Mandatory course: no
Language of instruction: German
Assessment: Written exam
Curricular relevance: EE-K2-525 Energy system technology / Renewable energies, Bachelor, ASPO 01.10.2012, semester 6, optional course EE-K2-525 Energy system technology / Renewable energies, Bachelor, ASPO 01.04.2015, semester 6, optional course, course inactive since 14.03.2018 E2427 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, optional course, general subject KI585 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2014, semester 6, optional course, non-technical KIB-RFA2 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2017, semester 6, optional course, non-technical MAB.4.2.1.22 Mechanical and Process Engineering, Bachelor, ASPO 01.10.2013, semester 6, optional course MAM.2.1.1.21 Engineering and Management, Master, ASPO 01.10.2013, optional course, general subject MST.RA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2012, semester 6, optional course, non-technical, course inactive since 14.03.2018 MST.RA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2019, semester 6, optional course, non-technical, course inactive since 14.03.2018 PIBWN34 Applied Informatics, Bachelor, ASPO 01.10.2011, semester 6, optional course, not informatics specific PIB-RFA2 Applied Informatics, Bachelor, ASPO 01.10.2017, semester 6, optional course, not informatics specific
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Christine Sick

Lecturer: Prof. Dr. Christine Sick

[*updated 31.03.2020*]

Learning outcomes:
The modules _Russian for Beginners 1_ and _Russian for Beginners 2_ are based on one another. In the course of the two modules, participants will first reach proficiency level A1 and then advance to level A2 of the European Framework of Reference for Languages. The course _Russian for Beginners 2_ is aimed at learners with basic knowledge of the Russian language at level A1 of the European Reference Framework or the module _Russian for Beginners 1_.
The goal of the course is to provide students with basic knowledge of the Russian language, which will enable them to communicate in general and professional situations, both orally and in writing. To do so, all four skills (speaking, listening comprehension, reading and writing) will be trained equally. We will focus on oral communication in order to develop communicative competence in work-related situations, especially through role playing and the use of dialogues. Important grammatical structures will be taught in order to support and supplement the content of the course.
During the course, intercultural aspects will also be addressed so that students develop an awareness of cultural specificities and are able to act and communicate appropriately and competently in the respective situations.

[*updated 19.02.2018*]

Module content:
In the course _Russian for Beginners 2_ selected lessons from the textbook _Otlitschno 2_ will be worked on.
Work
_ Organizing daily and weekly schedules
_ Times, opening hours
_ Making business calls
_ Writing memos
The professional world
_ Writing and responding to invitations
_ Making hotel reservations per telephone/e-mail
_ Developing an event program for business partners
_ Describing how a company is structured
_ Naming tasks and responsibilities
Professional training and experience
_ Creating a resume
_ Reading and understanding job advertisements
Intercultural competence
Basic knowledge about Russian culture, history and society
In addition, basic grammatical structures (e. g. numbers, time and date, use and declination of nouns, adjectives and personal pronouns, prepositions, verb conjugation, sentence structure) will be taught.
Students are expected to work on and expand their basic vocabulary independently.

[*updated 19.02.2018*]

Teaching methods/Media:
Teaching and learning materials (print media, slides, audio-visual teaching materials) compiled specifically for the learning group and recommended podcasts at www.russlandjounal.de

[*updated 19.02.2018*]

Recommended or required reading:
The course is based on the following textbook and will be supplemented by the following:
Otlitschno 2 Lehrbuch ISBN: 978-3-19-0044778-8 und Arbeitsbuch ISBN: 978-3-19-014478-5

[*updated 19.02.2018*]

Spanish for Beginners I

Module name (EN): Spanish for Beginners I

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2424

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 2

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written examination (final exam)

Curricular relevance:
E2424 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, optional course, non-technical
KI663 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2014, semester 5, optional course, non-technical
KIB-SFA1 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2017, semester 5, optional course, non-technical
MAB.4.2.1.4 Mechanical and Process Engineering, Bachelor, ASPO 01.10.2013, semester 5, optional course
MST.SA1 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2012, semester 5, optional course, non-technical
MST.SA1 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2019, semester 5, optional course, non-technical
PIBWN50 Applied Informatics, Bachelor, ASPO 01.10.2011, semester 5, optional course, not informatics specific
PIB-SFA1 Applied Informatics, Bachelor, ASPO 01.10.2017, semester 5, optional course, not informatics specific
MST.SA1 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2011, semester 5, optional course, non-technical

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Christine Sick

Lecturer: Prof. Dr. Christine Sick

[*updated 31.03.2020*]

Learning outcomes:
The course "Spanish for Beginners I" is aimed towards learners with little or no previous knowledge of the Spanish language. The courses "Spanish for Beginners I and II" are based on each other. In the course of the two modules, students will first reach proficiency level A1 and then advance to level A2 of the European Framework of Reference for Languages.

The goal of the course is to provide students with basic knowledge of the Spanish language, which will enable them to communicate in general and professional situations as quickly as possible, both orally and in writing. To do so, all four skills (speaking, listening comprehension, reading and writing) will be trained equally. Content development will be supported by the repetition of the relevant grammatical structures.

The course takes a communicative and pragmatic approach that particularly promotes communicative competence in job-relevant situations through the use of role playing and situational dialogues. This also includes intercultural aspects that raise the students´ awareness of cultural differences and enable them to assert themselves in specific situations.

[*updated 24.02.2018*]

Module content:
Content:
In the course _Spanish for Beginners I_ students will learn the lessons 1 to 5 from _Meta Profesional A1-A2_ (Spanisch für den Beruf. Klett Verlag).

Establishing contact
- Formal greetings
- Introductions
- Asking how someone is feeling
- Giving information about yourself and requesting information about others
- Saying thank you, apologizing and saying goodbye
- Describing a person
- Giving directions
- Getting to know business partners

- Job profiles and the workplace
- Describing jobs and activities
- Types of companies
- Showing and describing products
- Describing departments and responsibilities
- Planning activities
- Interaction with colleagues
- Participating in international trade fairs

Oral and written communication
- Common verbal expressions (asking for names, telephone numbers and e-mail addresses)
- Business lunches
- Making appointments with colleagues
- Requesting and giving information
- Writing e-mails
- Time
- Daily schedule, making appointments

In addition, basic grammar structures will be learned (e. g. indicative presence of regular and irregular verbs, form of progression, prepositions, personal and possessive pronouns, asking questions, syntax).

Students should work on and expand their basic vocabulary independently.

[*updated 19.02.2018*]

Teaching methods/Media:
Teaching and learning materials (print media, slides, audio-visual teaching materials), multimedia learning software compiled specifically for the learning group.

[*updated 19.02.2018*]

Recommended or required reading:
The course is based on the following textbook and will be supplemented by additional learning material:
Meta Profesional _ Spanisch für den Beruf, Lehrbuch ISBN: 978-3-12-515460-5

We also recommend these books for grammar:
Uso de la Gramática Española. Nivel Elemental. ISBN 3-12-5358116-6
Spanische Grammatik für Selbstlerner 01 Bd.1 ISBN-10: 3896577093
Tiempo para conjugar. Buch mit CD-Rom, PC, Mac. ISBN 3-12-535809-4

Students will receive a list of recommended teaching and learning materials.

[*updated 19.02.2018*]

Spanish for Beginners II

Module name (EN): Spanish for Beginners II

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2425

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 2

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written examination (final exam)

Curricular relevance:
E2425 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, optional course, non-technical
KI664 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2014, semester 6, optional course, non-technical
KIB-SFA2 Computer Science and Communication Systems, Bachelor, ASPO 01.10.2017, semester 6, optional course, non-technical
MAB.4.2.1.5 Mechanical and Process Engineering, Bachelor, ASPO 01.10.2013, semester 6, optional course
MST.SA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2012, semester 6, optional course, non-technical
MST.SA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2019, semester 6, optional course, non-technical
PIBWN51 Applied Informatics, Bachelor, ASPO 01.10.2011, semester 6, optional course, not informatics specific
PIB-SFA2 Applied Informatics, Bachelor, ASPO 01.10.2017, semester 6, optional course, not informatics specific
MST.SA2 Mechatronics and Sensor Technology, Bachelor, ASPO 01.10.2011, semester 6, optional course, non-technical

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Christine Sick

Lecturer: Prof. Dr. Christine Sick

[*updated 31.03.2020*]

Learning outcomes:
The courses "Spanish for Beginners I and II" are based on each other. In the course of the two modules, students will first reach proficiency level A1 and then advance to level A2 of the European Framework of Reference for Languages.

The course Spanish for Beginners II_ is aimed at learners with basic knowledge of the Spanish language at level A1 of the European Reference Framework or the module _Spanish for Beginners I_.

The goal of the course is to provide students with basic knowledge of the Spanish language, which will enable them to communicate in general and professional situations as quickly as possible, both orally and in writing. To do so, all four skills (speaking, listening comprehension, reading and writing) will be trained equally. Content development will be supported by the repetition of the relevant grammatical structures.

The course takes a communicative and pragmatic approach that particularly promotes communicative competence in job-relevant situations through the use of role playing and situational dialogues. This also includes intercultural aspects that raise the students´ awareness of cultural differences and enable them to assert themselves in specific situations.

[*updated 24.02.2018*]

Module content:
Content:
In the course _Spanish for Beginners II_ students will learn the lessons 6 to 10 from _Meta Profesional A1-A2_ (Spanisch für den Beruf, Klett Verlag).

Work
- Describing your private and professional daily routine
- A day at work: habits and time
- Talking about preferences
- Agreeing and objecting to things
- Talking about experiences
- Opening hours
- Organizing a weekly schedule
- Talking about plans

Talking on the telephone
- Making business calls

Business appointments
- Making, accepting and rejecting invitations and suggestions
- Arranging appointments
- Talking about the weather
- Making a hotel reservation
- Planning business meals
- Deciding what is most important at the first meeting with a customer

Products and projects
- Describing buildings and offices
- Assessing and describing products and prices
- Talking about quantities
- Preparing a company presentation

Professional training and experience
- Reading job advertisements
- Composing an application cover letter
- Skills, strengths and weaknesses
- Creating a resume
- Participating in a job interview

In addition, we will concentrate on basic grammatical structures (such as for example, the imperative, future and past of regular and irregular verbs). Students should work on and expand their basic vocabulary independently.

[*updated 19.02.2018*]

Teaching methods/Media:
Teaching and learning materials (print media, slides, audio-visual teaching materials), multimedia learning software compiled specifically for the learning group.

[*updated 19.02.2018*]

Recommended or required reading:
The course is based on the following textbook and will be supplemented by additional learning material:
Meta profesional A1-A2 Spanisch für den Beruf. Klett Verlag; ISBN: 978-3-12-515460-5

We also recommend these books for grammar:

Uso de la Gramática Española. Nivel Elemental. ISBN 3-12-5358116-6
Spanische Grammatik für Selbstlerner 01 Bd.1 ISBN-10: 3896577093
Tiempo para conjugar. Buch mit CD-Rom, PC, Mac. ISBN 3-12-535809-4

Students will receive a list of recommended teaching and learning materials.

[*updated 19.02.2018*]

Systems Engineering

Module name (EN): Systems Engineering

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2572

Hours per semester week / Teaching method: 2PA (2 hours per week)

ECTS credits: 3

Semester: 5

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
E2572 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Buchholz

Lecturer: Prof. Dr. Martin Buchholz

[*updated 10.09.2018*]

Learning outcomes:
After successfully completing this module, students will be able to translate an interdisciplinary task from a complex system into concrete results using a methodical approach.

[*updated 08.01.2020*]

Module content:
Project work based on a specific, complex task definition using the methodology learned: Requirements analysis and definition - System design (calculation, simulation, evaluation) - System integration - System verification and validation - Project and risk management - Sustainable development and optimization

[*updated 08.01.2020*]

Teaching methods/Media:
Coaching during the project

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Technical Documentation

Module name (EN): Technical Documentation

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2580

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 2

Semester: 5

Mandatory course: no

Language of instruction:
German

Assessment:

Curricular relevance:
E2580 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Walter Calles

Lecturer:
Dipl.-Ing. Irmgard Köhler-Uhl

[*updated 08.04.2020*]

Learning outcomes:
After successfully completing this course, students will be able to examine and verify subject-related texts. They will be able to analyze different text forms based on examples with regard to their target group intentions. This will enable them to identify the influences caused by special text design features and develop structures for simpler text creation. The documentation of research and work findings, including how to handle quotations and Internet sources, their identification in texts and the creation of a bibliography will enable students to create technical/scientific texts more efficiently.

[*updated 08.01.2020*]

Module content:
1 Text design in standards, guidelines and laws 2 Rules for technical texts 3 User manuals 4 Abstracts/text summaries 5 Comprehensibility of texts 6 Business correspondence 7 Notes, transcripts, minutes, reports 8 Structuring and numbering texts 9 Citation rules 10 Bibliographies 11 Time management for the creation of longer texts

[*updated 08.01.2020*]

Teaching methods/Media:
Lecture notes

[*updated 08.01.2020*]

Recommended or required reading:

[*still undocumented*]

Using Microcontroller Technology

Module name (EN): Using Microcontroller Technology

Degree programme: Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018

Module code: E2540

Hours per semester week / Teaching method: 2PA (2 hours per week)

ECTS credits: 2

Semester: 5

Mandatory course: no

Language of instruction:
German

Assessment:
Oral examination (50%), project work (50%)

Curricular relevance:
E2540 Electrical Engineering and Information Technology, Bachelor, ASPO 01.10.2018, semester 5, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Dietmar Brück

Lecturer: Prof. Dr.-Ing. Dietmar Brück

[*updated 10.09.2018*]

Learning outcomes:
Based on previous lectures, this module will familiarize students with the applications of microcontrollers in defined areas of automation technology. After successfully completing this course, students will be able to analyze tasks and justify their selected approach. They will then be capable of implementing their approach using hardware and software and thus, designing a functional prototype Finally, students will be able to test their prototype and modify the solution to achieve better results. Where necessary, students will have the opportunity to consult with the lecturer and/or carry out simulations. Our primary focus will be the technical application of skills.

[*updated 08.01.2020*]

Module content:
1. Planning circuits using various controllers and construction of the planned circuits 2. Programming the resp. applications 3. Setting up and implementing the resp. applications

[*updated 08.01.2020*]

Teaching methods/Media:
Project

[*updated 08.01.2020*]

Recommended or required reading:
Horacher, Martin: Mikrocomputer, TU Wien, 1999 Klaus, Rolf: Der Mikrocontroller C167, VDF Hochschulverlag, 2000 Schultes, Renate; Pohle, Ingo: 80C166 Mikrocontroller, Franzis, 1998, ISBN 978-3772358937

[*updated 08.01.2020*]