Technische Hochschule Rosenheim

Faculty of Engineering

Curriculum

of the

International Bachelor of Engineering

Specialisation in Electrical Engineering and Information Technology

at Rosenheim Technical University of Applied Sciences

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Contents

1 Introduction

Engineers drive innovation and are technology integrators and enablers for almost all sectors of the economy in Germany. The International Bachelor of Engineering degree programme will enable you to take on managerial functions in engineering occupational fields and to function in higher-level and coordinating cross-sectional positions, as the degree programme provides a sound insight into the task areas of modern engineering sciences. In addition, you will have international competences as well as excellent German and English skills after completing your studies. In the course of globalisation, industry is becoming increasingly international and needs engineers with international competence and language skills. These professionals combine regional, national and international levels and fields of activity, for example in industry (product development and manufacturing, software development, service, marketing and sales, planning, operation and testing of equipment/plants, quality management). Generalist basic studies, which contain engineering fundamentals and integrated German language courses are followed by the main studies in a specialisation chosen during the study programme. The core subjects of the chosen specialisations deal with mechanical, constructional, electrotechnical, materials or medical technology topics. At Rosenheim campus, students can choose from the following specialisations: Electrical Engineering and Information Technology, Energy and Building Technology,Engineering and Management, Plastics Engineering / Sustainable Polymer Engineering, Mechanical Engineering, Mechatronics or Medical Technology. In addition to an interdisciplinary, well-balanced range of modules at the respective campus and department, you can choose from attractive specialisation modules in the advanced course of study in each focus area and build up specific knowledge. This individual competence profile also enables you to manage very specialised projects or departments.
Electronic devices and systems have become an integral part of our everyday lives; in the form of smartphones, tablets, household appliances and vehicles; in the personal sphere, as well as in our infrastructure, which supplies us with energy, food and information. Increasingly, even small devices are “networked” into systems, i.e. they can communicate with other devices or have worldwide access to the internet - keyword IoT (Internet of Things). These systems are called “intelligent” if they are able to decide and act autonomously.

The International Bachelor of Engineering with the specialisation Electrical Engineering and Information Technology enables students to participate in the development, production, marketing and operation of such “intelligent networked systems”. In addition to the fundamentals of electrical engineering and electronics, students acquire knowledge and skills

in communication and automation technology, as well as computer science and artificial intelligence. Our graduates are in demand in communication, automation and medical technology, in mechanical and plant engineering, in the automotive, aerospace and renewable energy industries. The good laboratory equipment, motivated professors as well as the best industry contacts distinguish the study programme at Rosenheim Technical University of Applied Sciences.

Note:

Students who are not sure whether they want to study Electrical Engineering and Information Technology or one of the other specialisations Mechatronics, Medical Technology, Plastics Engineering/Sustainable Polymer Engineering, Engineering and Management, Energy and Building Technology or Mechanical Engineering at TH Rosenheim have the option of a flexible start semester in the IBE. Because the modules in the first semester of the EIT specialisation are identical to those of the other specialisations of the IBE, students can easily change to the specialisation of their choice after the first semester.

2 Qualification & study goals

The study programme in the specialisation of Electrical Engineering and Information Technology aims to provide an education based on scientific knowledge and methods through application-oriented teaching. Graduates should be qualified to work independently as a Bachelor of Engineering.

The specialisation is intended to qualify students for engineering activities in the following fields of work:
* Development (conception, design, calculation, simulation and construction of hardware and software for electronic assemblies, devices, systems and installations), * Manufacturing (production, quality assurance), * Project planning (system design of electronic components, assemblies and systems), * Assembly, commissioning and service, * Operation and maintenance, * Monitoring and appraisal, * Technical operations and management

Attention is paid to a broad, qualified and interdisciplinary education, which enables graduates to work in a wide range of professions. Career opportunities are offered not only in business and utility companies, but also in public service administrations and in independent practice.

Knowledge, skills and competences can be found in the following overview:

1. Scientific-Technical Basics

- ***Knowledge:*** The students know basic mathematical terms and methods as well as physical, electrical and information technology basics.
- ***Skills:*** Students understand the procedures, are able to comprehend them and engage in more advanced methods.
- ***Competences:*** The students use the scientific-technical knowledge and skills to solve “electrical engineering and information technology” technical problems.

2. Subject-Specific Technical Basics

- ***Engineering fundamentals and knowledge:*** Students know basic “electrical and information engineering” technical terms and methods.
- ***Skills:*** Based on the knowledge and methods, students can analyse and solve problems.
- ***Competences:*** Students can select and implement procedures for the development of new, innovative devices and development processes or make decisive contributions to them.

3. Subject-Specific Technical Specialisation

- ***Knowledge:*** The general fundamentals are specialised in the sub-areas of electrical engineering and information technology; by choosing the relevant FWP modules and project topics, it is possible to focus on the areas of “automation technology”, “communication technology”, “chip design” and “machine learning”.
- ***Skills:*** Technical problems from the above-mentioned areas can be analysed and evaluated. Development methods and technical procedures can be applied to new problems.
- ***Competences:*** Procedures and problem solutions from the above-mentioned areas can be elaborated and further developed.

4. Interdisciplinary, Social and Methodological Competences.

- ***Knowledge:*** Current trends and currents in the information society are identified. The necessity of independent lifelong learning is recognised. The students acquire basic communication, organisational and presentation skills that enable them to work independently as well as in teams.
- ***Skills:*** Students are able to form their own opinion on a topic and present it in a comprehensible way.
- ***Competences:*** Influence the development of new technical products through innovative use. Effects of “electrical engineering and information technology” on the environment and society are recognised, harmful influences are avoided. Working on technical tasks in a team.

The degree programme can also be studied in the practice-integrated dual study variants “study with in-depth practice” or “combined study”; detailed explanations on this can be found in the following chapter.

3 Structure of the study programme and Rosenheim study model

The International Bachelor of Engineering programme leads to a Bachelor of Engineering degree in eight semesters, i.e. four years. The basic studies during the first three semesters include central engineering and integrated German language courses. These are taught predominantly in English. At the same time, you will acquire the necessary German language skills to switch to the German-language main studies from the fourth semester onwards and complete your studies in German. For this purpose, you will complete three semesters of German courses worth 10 CP per semester, beginning with the acquisition of language level B1 according to the CEFR (Common European Framework of Reference for Languages) - German language skills at level A2 according to the CEFR are a language admission requirement for the degree programme. The acquisition of German language skills up to level C1 according to the CEFR within the framework of the basic study programme qualifies you to transfer to the German-language main study programme. Language acquisition supports successful internships and creates the basis for a successful connection to the regional labour market. In addition, there is a common starting semester that qualifies students to study in any specialisation. From the second semester onwards, subject-specific compulsory modules complement the joint modular studies at the Rosenheim campus. From the second semester onwards, the compulsory modules required for training are added at the Rosenheim campus. These can be divided into the areas of medicine, construction, materials, electrical engineering and information technology. From the third semester onwards, foreign students are introduced to German-language studies through selected German-language courses. In addition to the compulsory modules, from the fourth semester onwards students have the opportunity to take in-depth modules of their own choice in the defined areas. In addition to the German language modules with 30 CPs, the basis of the programme is a broad basic education in engineering subjects. This includes 15 CPs of mathematics, 5 CPs of physics, 5 CPs of technical mechanics and 5 CPs of engineering informatics, which form the basis for all participating engineering degree programmes at Rosenheim campus. The first semester is the same for all degree programmes. Diversification begins in the second semester and is then clearly noticeable in the third semester, because in this semester individual modules are predominantly offered for each degree programme.

Examination Concept All modules correspond to at least 5 ECTS and have their own examination in the usual forms of examination in engineering degree programmes, such as midterm

examinations, written and oral examinations, examination papers, colloquium, project work or term paper.

Rosenheim study model

The Bachelor's degree programmes of the Faculty of Engineering are structured according to the Rosenheim study model and are thus optimally geared towards an intensive interlocking of theory and industrial practice. The Rosenheim study model has the following features.

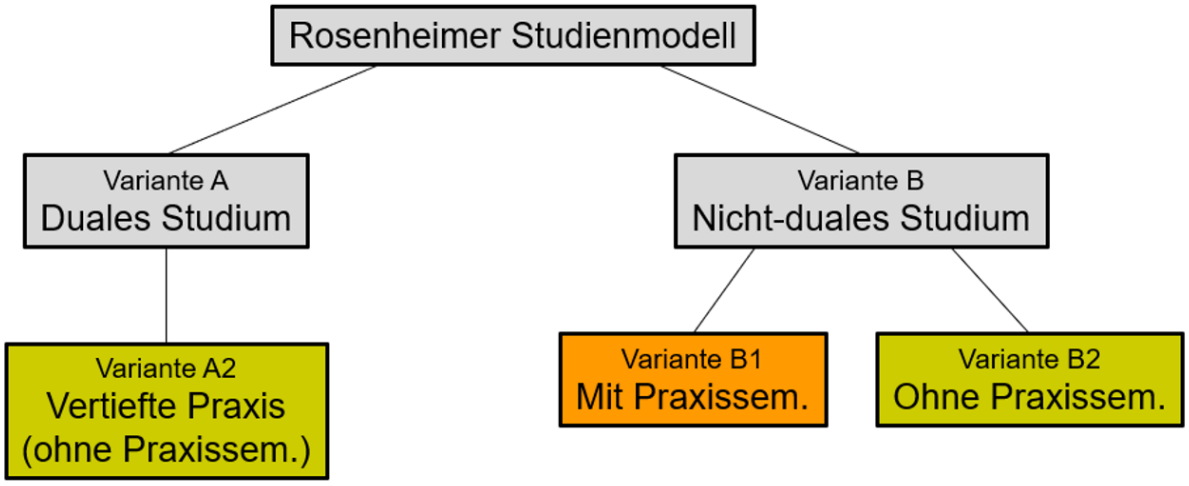
1. Dual study and non-dual study

The Rosenheim study model is suitable both as a dual study programme and as a non-dual study programme. The dual study programme is possible both as a combined study programme and in in-depth practice.

2. With practical semester and without practical semester

According to the Rosenheim study model, it is possible to complete the required study-related internship in a classic practical semester (with practical semester) or in the lecture-free periods (practical phases) between the theory phases (without practical semester).

According to the Rosenheim study model, this results in the study variants shown here:



3. Adjustment of the lecture times

The lecture times in the Rosenheim study model have been adjusted for a more intensive dovetailing of theory and industrial practice. The lecture times in the 1st, 2nd, 3rd and 4th semesters correspond to the usual lecture times at the universities of applied sciences in Bavaria. In the 5th, 6th, 7th and 8th semesters, the lecture periods begin two weeks later, i.e. for these semesters, the lecture periods begin at the beginning of April in the summer semester and in mid-October in the winter semester. The end of lectures in all semesters is

the same as the usual end of lectures at the universities of applied sciences in Bavaria. This means that there is nothing to prevent students from transferring to or from other university locations. The examination period specified by Rosenheim Technical University of Applied Sciences also applies in the Rosenheim study model. This results in extended practical phases after semesters 3 to 6 (P3 to P6).

The special features and the time structure of the study variants are shown below

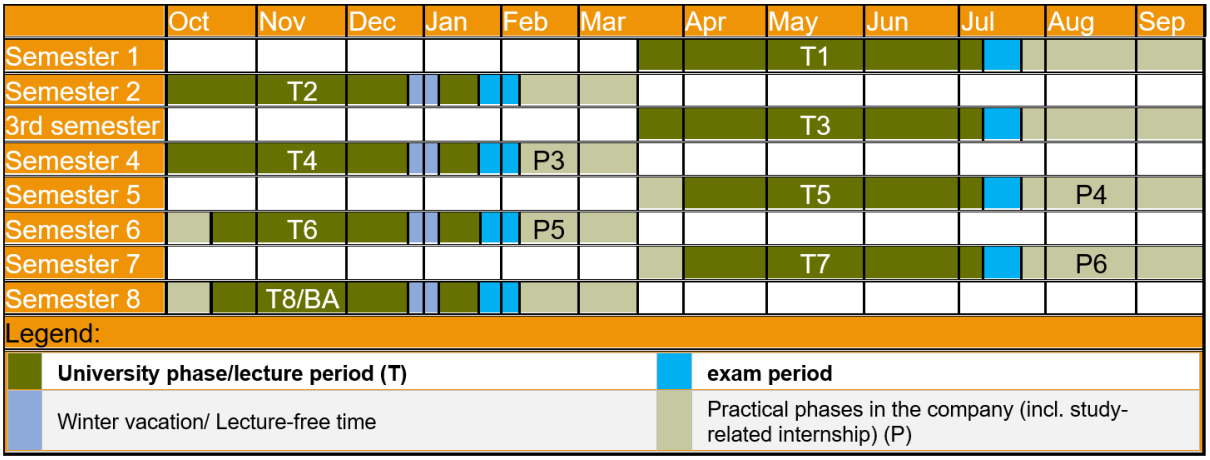
Variant A: Dual study

The study programme according to the Rosenheim study model is particularly suitable as a dual study programme with in-depth practice. The learning locations of university and company are systematically interlinked in terms of content, organisation, contract and time.

Variant A2: Dual study programme with in-depth practice

In the study programme with in-depth practice, a regular Bachelor's programme at the university is combined with intensive practical phases at the practice partner, based on the study content. University and practical phases systematically alternate in the degree programme with in-depth practice. For this purpose, the dual students go through intensive practical phases in the company during the lecture-free period. The knowledge acquired in the theoretical phases is reflected upon and applied. For studies with in-depth practice, the study model without a practical semester is recommended.

The study procedure is shown here:



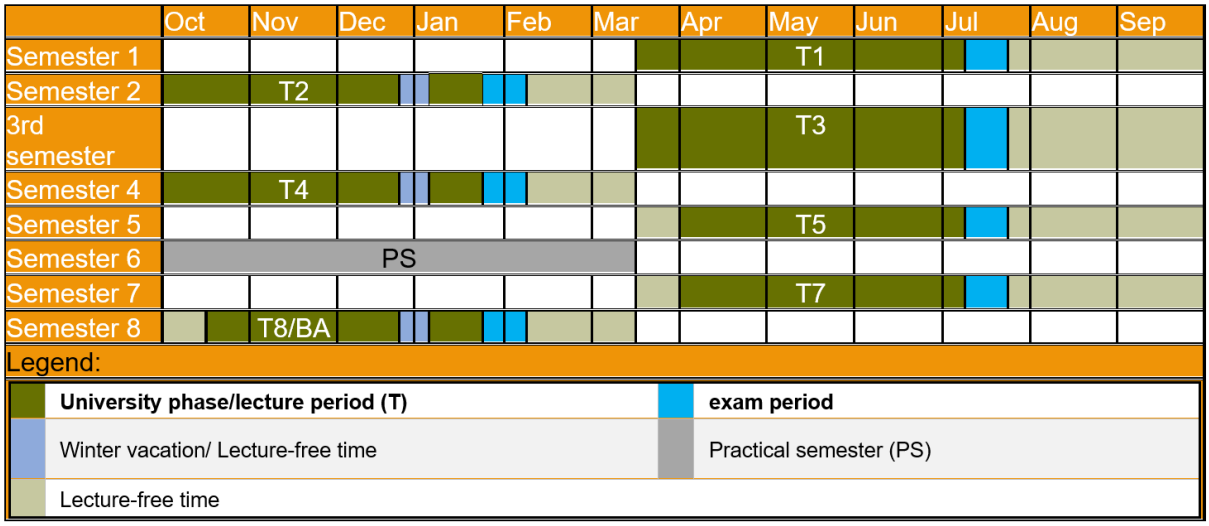
Variant B: Non-dual study

Variant B1: Non-dual study programme with practical semester

The study-related internship is completed in a practical semester (6th study semester). Studying according to this model is particularly suitable for the following students:

- Students who wish to have a larger coherent block of time for the study-accompanying internship.
- Students who would like to complete their study-related internship abroad (internship semester as a mobility window).

The study procedure is shown here:

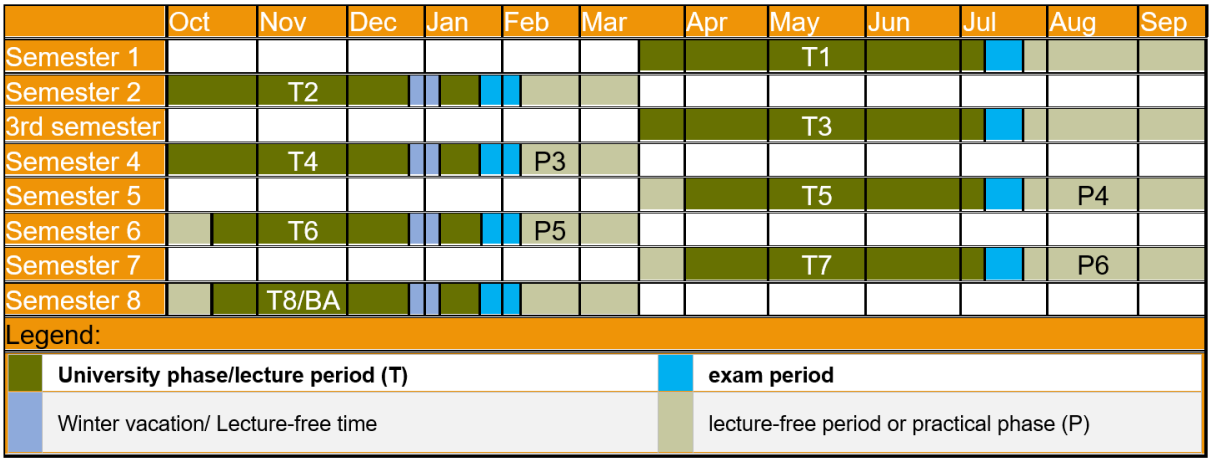


Variant B2: Non-dual study programme without practical semester

Studying according to this model is particularly suitable for the following students:

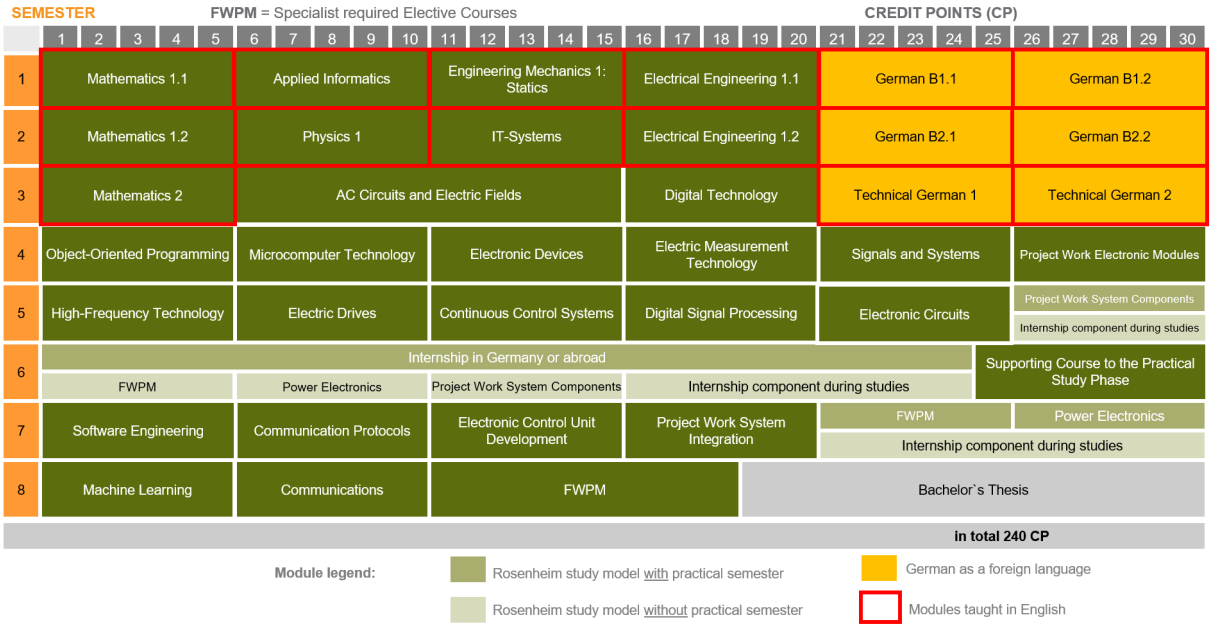
- Students who want to divide the study-related internship into several practical phases.
- Students who want to spend a semester abroad (5th semester as mobility window, see chapter Internationalisation / Study-related stays abroad in the respective curricula)

The study procedure is shown here:



4 Module Overview

5 Study plan


SEMESTER
FWPM = Specialist required Elective Courses
CREDIT POINTS (CP)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
1 Mathematics 1.1 Applied Informatics Engineering Mechanics 1: Statics Electrical Engineering 1.1 German B1.1 German B1.2
2 Mathematics 1.2 Physics 1 IT-Systems Electrical Engineering 1.2 German B2.1 German B2.2
3 Mathematics 2 AC Circuits and Electric Fields Digital Technology Technical German 1 Technical German 2
4 Object-Oriented Programming Microcomputer Technology Electronic Devices Electric Measurement Technology Signals and Systems Project Work Electronic Modules
5 High-Frequency Technology Electric Drives Continuous Control Systems Digital Signal Processing Electronic Circuits Project Work System Components
Internship component during studies
6 Internship in Germany or abroad
Supporting Course to the Practical Study Phase
FWPM Power Electronics Project Work System Components Internship component during studies
7 Software Engineering Communication Protocols Electronic Control Unit Development Project Work System Integration FWPM Power Electronics
Internship component during studies
8 Machine Learning Communications FWPM Bachelor`s Thesis
in total 240 CP
Module legend:
Rosenheim study model with practical semester
Rosenheim study model without practical semester
German as a foreign language
Modules taught in English

The following table shows the study plan for the study programme according to the Rosenheim study model with practical semester or without practical semester:

Modul or Modul Group	Module Name or Designation of the Module Group	Study model with practical semester									Study model without practical semester								
		Semester									Semester								
		1	2	3	4	5	6	7	8	Σ CP	1	2	3	4	5	6	7	8	Σ CP
IBR11	German B1.1	5								5	5								5
IBR12	German B1.2	5								5	5								5
IBR13	Mathematics 1.1	5								5	5								5
IBR14	Electrical Engineering 1.1	5								5	5								5
IBR15	Applied Informatics	5								5	5								5
IBR16	Engineering Mechanics 1:	5								5	5								5
IBR21	German B2.1		5							5		5							5
IBR22	German B2.2		5							5		5							5
IBR23	Mathematics 1.2		5							5		5							5
IBR24	Physics 1		5							5		5							5
IBR25.2	Electrical Engineering 1.2		5							5		5							5
IBR25.6	IT-Systems		5							5		5							5
IBR31	Technical German 1			5						5			5						5
IBR32	Technical German 2			5						5			5						5
IBR33	Mathematics 2			5						5			5						5
EIT22	Digital Technology			5						5			5						5
EIT24	AC Circuits and Electric Fields			10						10			10						10
EIT31	Object-Oriented Programming				5					5				5					5
EIT32	Microcomputer Technology				5					5				5					5
EIT33	Electronic Devices				5					5				5					5
EIT34	Electric Measurement Technology				5					5				5					5
EIT35	Signals and Systems				5					5				5					5
EIT3-P	Project Work Electronic Modules				5					5				5					5
EIT41	Communication Protocols							5		5							5		5
EIT42	Electric Drives					5				5					5				5
EIT43	Continuous Control Systems					5				5					5				5
EIT44	Digital Signal Processing					5				5					5				5
EIT45	Electronic Circuits					5				5					5				5
EIT4-P	Project Work System Components					5				5						5			5
EIT61	Software Engineering							5		5							5		5
EIT62	Power Electronics							5		5						5			5
EIT63	Electronic Control Unit Development							5		5							5		5
EIT64	High-Frequency Technology					5				5					5				5
EIT6-P	Project Work System Integration							5		5							5		5
EIT71	Machine Learning								5	5								5	5
EIT72	Communications								5	5								5	5
MG-FWPM	Specialist Required Elective Courses							5	8	13						5		8	13
PLV	Lectures for Practical Internship						6			6						6			6
SP	Practical Internship						24			24					5	9	10		24
BA	Bachelor`s Thesis								12	12								12	12
	Σ CP	**30**	30	**30**	30	**30**	30	**30**	30	**240**	30	**30**	30	**30**	30	**30**	30	**30**	**240**

6 Modules and their options

The individual modules combine thematically related teaching content. All modules numbered IBR11 to IBR24 and IBR25 to IBR33 of the basic studies as well as with number EIT31 to EIT72 as well as the modules of the module group Practice Accompanying Courses (MG-PLV) and the Bachelor thesis are compulsory modules and must be taken. For the module group of the subject-specific compulsory elective modules IBR25 in the basic studies, the students must make a selection of FWPMs corresponding to the specialisation of Electrical Engineering and Information Technology, so that the specified number of 25 ECTS points is achieved. The range of elective compulsory modules IBR25 is unchangeable. For the module group of the discipline-related elective courses (MG-FWPM), the students must make a suitable selection of FWPM from the catalogue of the faculty so that the minimum number of 13 ECTS points specified for this is achieved.

For the main study course from 4th – 8th Semester, the module descriptions in this handbook are in German only. For English short descriptions of each module, please go to IBE- Electrical Engineering and Information Technology.

Subject-specific compulsory elective modules:

The elective offer of FWPM can change from semester to semester. For the selection of the subject-specific elective modules for the next semester, elective documents are published in the online community of the TH Rosenheim at about the end of the second third of the lecture period of the current semester. In the last weeks of the lecture period, students can then register by course selection. The catalogue of subject-specific compulsory elective modules valid for the next semester is announced at the same time. The currently valid catalogue for the faculty (FWPM-ING) can be found here:

FWPM-ING

7 Guidelines for project work

Three project works are planned[1], which are carried out at the university in the case of non-dual studies and at the student's partner company in the case of dual studies:

Studiensemester	Projektarbeit	Modulname lt. SPO	ECTS-CPs
3	Erste Projektarbeit *Elektronische Baugruppen*	EIT3-P	5
4 bzw. 5 [1]	Zweite Projektarbeit *Systemkomponenten*	EIT4-P	5
6	Dritte Projektarbeit *Systemintegration*	EIT6-P	5

In the following text, the ***special features for dual students*** are set in [*in square brackets & italics*].

Projects within the university are usually worked on by several students together - [*projects in the company usually alone, but there can also be several participants*]. The workload for a project with 5 ECTS-CPs is 150 h - see also the *Module descriptions* at the last chapter of this curriculum.

7.1 Learning objectives

The subject-related content of a project work should be oriented to the course content of the respective semesters and follow the study objective *Intelligent Networked Systems*. The three project works have the following ***overarching learning objectives***:

- Skill in systematic engineering work
- Ability to (co-)develop hardware and software of networked intelligent systems
- Ability to clarify complex tasks with those responsible for the project and colleagues, to develop, evaluate, select and present alternative solutions, and to acquire any missing knowledge in the process through self-study

The individual learning objectives for each project work can be found in the module descriptions in the last section of this curriculum.

[1] The second project work (EIT4-P) can be carried out either in the 5th semester of studies with a practical semester (recommended for combined studies) or in the 6th semester of studies without a practical semester (recommended for in-depth practice).

7.2 Contents

For the projects started in the 4th semester, continuations should be offered in the 5th/6th and in the 7th semester, if possible - but the successive follow-up projects are not a “must” - neither for the students, nor for the lecturers offering them [or for the partner companies]. Possible contents of the three project works are listed in the respective module descriptions in the last section of this curriculum; a short presentation of all currently offered topics can be found in the course room **“EIT-B project works” in the *Learning Campus***

7.3 Formalia

For both internal university project work [*and for project work in the partner company of dual students*], the work begins with the *choice of the topic*. The work is then formally *registered* at the latest at the beginning of the semester [*dual: at the end of the lecture period*] and worked on during the semester. Finally, the *submission* and the *assessment* by an examiner takes place by the end of the semester:

7.3.1 Topic selection

For non-dual students: The offered project topics are presented in the last 3 weeks of the lecture period of the previous semester - online in the course room **“EIT-B project works” in the *Learning Campus***. The selection and assignment of the topics to the students then takes place in the last week of lectures in the context of a face-to-face meeting at which all the lecturers offering the project and all the students looking for a project are present and inform themselves and introduce themselves to the project leaders in the style of a “job speed dating”

For dual students: [*The topics of the project work are defined by the students and their partner companies. The subject-specific supervision of the students in the company is carried out by an experienced member of staff who ensures that the project results meet the requirements of the company. The supervision at the university is provided by a lecturer from the ING faculty who is familiar with the subject. Their task is to ensure a systematic approach, the application of recognised methods and suitability as an examination performance. They also assesses the project work. Students are obliged to inform the university supervisor about the progress of their work. Dual students who are not working on a project topic in the partner company will*

be assigned a topic from the university upon request. To do so, they must register in good time before the end of the examination registration period]

The choice of the topic, the finding of a suitable university supervisor [*and a company supervisor in the partner company*], as well as the formal registration with the examination board is in each case ***the student's responsibility!***

7.3.2 Submission of the work

The project work must be completed within one semester. The exact submission date (e.g. by the end of the lecture or examination period or at the end of the semester) is set by the supervising lecturer at the start of the work [*in consultation with the partner company*] - this date must in any case be *before* the start of the next semester (according to the Rosenheim study model), i.e. *before* 15 October or *before* 29 March. The topics of the project work are listed in the grade sheet. For this purpose, the supervising professor informs the examination office about the topic of the work, in German and in English.

The submission is ***in the form of a written report*** and ***a final presentation***:

- Project report and final presentation must be submitted to the supervisor in digital form by the agreed deadline.
- The report should be typically 15 to 20 (max. 30) pages in length.
- The exact form of the final presentation is determined by the supervisor at the university - it can also be conducted as a poster presentation, for example. The duration of the presentation is 15 to 20 minutes, plus discussion.
- The presentation will be assessed and will be included in the grade of the project work. Both the project report and the final presentation must clearly show the individual contributions of each participant.
- The university [*or the company*] shall ensure that the student can complete their work on time even in the event of possible problems for which they are not responsible (e.g. delivery delays of external components, defects in required machines). Failure to hand in the work on time will be assessed with a grade of *5.0*.

8 Examinations and Certificates of Achievement

During the registration period, students must register **for all certificates** such as written examinations, course-related certificates (e.g. internships, design work) **in the Online-Center register**. The registration period is usually in the first third of the lecture period and is announced publicly in the examination schedule (intranet).

In order to support rapid study progress, the following minimum achievements must be made:

The examinations in the modules “Mathematics 1” and “Physics 1” must be taken by the end of the second semester. If students exceed this deadline for reasons for which they themselves are responsible, the associated examinations shall be deemed to have been taken for the first time and not passed. Only those students are entitled to enter the fourth study semester and to continue their studies who

- at least 25 credit points from the subject-related study basics as outlined in the study and examinations regulations, and
- has achieved at least 20 credit points from the language modules “German as a Foreign Language” as outlined in the study and examinations regulations.

By the end of the first semester at the latest, students must decide on one of the following concentrations:

- Energy and Building Technology (Faculty of Applied Sciences and Humanities)
- Engineering and Management (Faculty of Management and Engineering)
- Electrical Engineering and Information Technology (Faculty of Engineering)
- Plastics Engineering / Sustainable Polymer Engineering (Faculty of Engineering)
- Mechanical Engineering (Faculty of Engineering)
- Mechatronics (Faculty of Engineering)
- Medical Technology (Faculty of Engineering).

Further information can be found in the **study and examination regulations** for the degree programme International Bachelor of Engineering. The exact details of the examinations, in particular of the compulsory elective modules, can be found in the “Announcement of the performance records”, which are published by the university at the beginning of each semester. The Bachelor thesis is an examination performance. The work begins with the issue of the topic by the examination committee. The maximum processing time is 5 months. If the maximum processing time is exceeded for reasons for which the student is responsible, the

examination is deemed to have been failed.

Deadlines:

The standard period of study, including the Bachelor's thesis, is 8 semesters. If the time limit is exceeded by more than 2 semesters, all examinations not yet taken by that time will be assessed as failed for the first time. It is therefore recommended that the certificates of achievement be completed as early as possible.

9 Internships

During the internship, which accompanies the studies, increasingly complex tasks are taken on in typical engineering projects. The internship comprises 18 weeks of activities. Please note the notices of the Internship Office regarding admission requirements and deadlines.

9.1 Training contract

Before starting practical work, a training contract must be concluded with the training institution. Templates for training contracts can be found on the **website of the Internship Office**. It is important to ensure that the training contract is properly completed:

- study-related internship
- When entering the details of the training place, it is important to make sure that, in addition to the company name, the company's field of activity and the exact address with telephone and email address are also given.
- Period (date from - to) of the internship
- Name of the company supervisor with indication of his job title
- Company stamp and signatures

Three signed copies of the contract must be submitted to the Internship Office for review before the start of the internship. The internship officer of the Electrical Engineering and Information Technology degree programme shall give their professional approval. If the internship position is changed, a new contract must be concluded. This must be submitted again in advance to the Internship Office and approved by the Internship Officer of the Electrical Engineering and Information Technology programme.

Sample contracts for dual students who enter into an employment relationship with a company can also be found on the **website of for dual students**.

9.2 Practical training during studies

9.2.1 Scope and timing

The 18-week internship accompanying the degree programme is completed as an industrial internship. It is possible to divide the internship into several blocks. These can also be

completed at several companies. A block comprises at least four weeks and includes a uniform problem. An interruption for examinations is permissible.

Timing: It can be carried out in a practical semester, which is planned as the 6th semester. Alternatively, the practical course can be carried out in the practical phases P3 to P6. The internship accompanying the course of study is intended to impart practice in engineering work. Without having studied at least three semesters, it is hardly possible to carry out engineering-related activities. Therefore, the internship should not be started before the practical phase P3. In case of doubt, consult the internship representative Electrical Engineering and Information Technology programme.

9.2.2 Training objective

The aim of the practical training accompanying the course is to introduce students to the activities and working methods of engineers on the basis of concrete tasks. The objectives of the associated practical courses (PLV) are the ability to think through operational processes competently and independently and to make decisions taking into account technical, economic and ecological aspects.

9.2.3 Training content of the industrial internship

The activities to be carried out during the internship must meet the requirements of engineering work. In principle, each student is responsible for this themselves. Ultimately, the internship officer only sees the contents when the report is submitted. This can lead to difficulties in the recognition of the internship if engineering activities are not sufficiently recognisable. If there is any doubt about the contents, it is advisable to consult the internship officer. The practical activities can be carried out in one or more of the following subject areas:

- Product development (hardware and software)
- Construction
- Project planning
- Manufacturing
- Distribution
- Assembly
- Quality assurance

- Research and development/ pre-development
- Commissioning
- Operational energy supply
- Service
- Work preparation
- Business organisation
- Information processing
- Procurement
- Logistics
- (other comparable areas are possible)

9.2.4 Training companies

Such companies are those in industry where the above-mentioned training content is offered and which are approved by Rosenheim Technical University of Applied Sciences. The trainee should be supervised by an experienced engineer.

9.2.5 Report card, internship report

The study-accompanying internship has been successfully completed if the individual internship periods with the prescribed contents have been proven in each case by a certificate from the training centre that corresponds to the model provided by Rosenheim Technical University of Applied Sciences, a proper internship report has been submitted to the Internship Office in due time and this has been assessed as passed by the Internship Officer of the Electrical Engineering and Information Technology degree programme. The report on the course-related internship is to be submitted as one report after completing the entire internship. The submission and recognition of partial reports is not possible. If several blocks have been completed, the report must contain all blocks.

The report is to be completed independently, conscientiously and in a clear form on DIN A4 sheets and includes the following content:

- Forms (available from the Traineeship Office): Cover sheet of general report, certificates, training programme
- Short company portrait in your own words
- Description of the activities (the engineering activity must be recognisable!):

- Detailed description of a thematic focus: tasks, possible preparatory work (e.g. available working materials, literature study, etc.), explanations and results, critical comments and conclusions. Supplement with sketches, drawings or graphical representations. In the case of confidential contents, the presentation may be based on general contexts / results without showing confidential results. The report is to be written in such a way that another student who is to continue working on the described topic can use it well for familiarisation.
- Short summary of all other topics dealt with.

The following structure is recommended for the report on the study-related internship:

```
1.  Cover sheet (TH template)
2.  Overall structure/ Table of contents
3.  Training course with stamp and signature of the companies (TH-
   template)
4.  Testimonials from the companies
5.  Description of the activities
    5.1 Detailed description of a thematic focus (approx. 10-20
       pages)
        5.1.1   Structure
        5.1.2   Short description of the company with integration in
            which part of the company the internship was completed.
        5.1.3   Task
        5.1.4   Description of the trainee activities with work
           results
        5.1.5   Summary with elaboration of the essential benefit
           for the trainee and for the company
    5.2 For all other topics not described under 5.1, a short (
       approx. 1/2 page) summary (company in which the topic was
       dealt with, task, activity, result).
6.  Bibliography
7.  Declaration to be made by hand with signature
```

9.2.6 Practical courses

The practice-related courses PLV1 to PLV3 are listed at the end of this document in the module descriptions.

10 Internationalisation / Study-related stays abroad

The International Bachelor of Engineering programme recommends spending an internship semester or a theory semester abroad during your studies. Rosenheim Technical University of Applied Sciences offers support for both projects through the International Office. The following describes how the stay abroad can be integrated into the course of studies.

10.1 Mobility window for the internship abroad

The 18-week internship accompanying the studies can be completed at home or abroad. If the study-related internship is to be completed abroad, it is particularly suitable to do it as a practical semester in the 6th semester (mobility window). It is recommended to consult with the representative for the practical semester before taking up an internship abroad.

General information on the internship semester can be found under Internship Office. Information on internships abroad can be found under International Office.

10.2 Mobility window for studying abroad

In principle, the study and examination achievements obtained abroad can be credited to the studies at Rosenheim Technical University of Applied Sciences, provided that there are no significant differences with regard to the competences acquired.

In the **study model with a practical semester**, the 7th or 8th semester is recommended for a study semester abroad. These semesters contain many courses that facilitate the recognition of study and examination achievements abroad, amounting to up to 30 ECTS credits per semester.

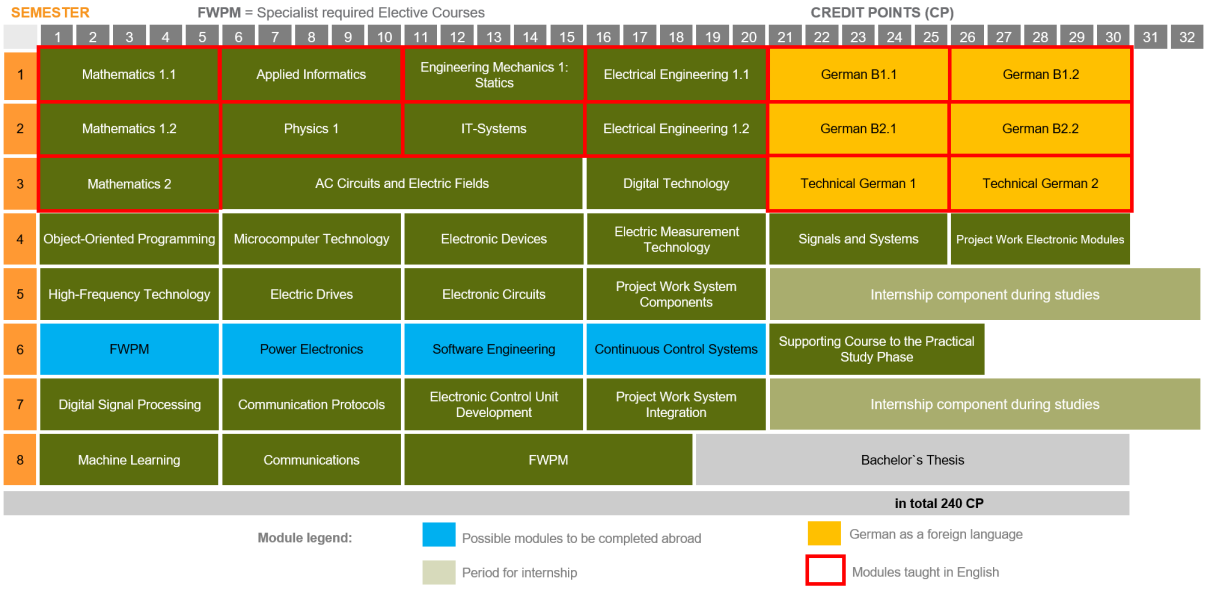
In the **study model without a practical semester**, the 6th semester is recommended for a study semester abroad. The following is an example of how the study plan can be optimised for a study period abroad. In this example, starting from the regular study plan, the practical components of the practical phase P6 are shifted to the practical phases P5 and P7, so that a pure theory semester results for the stay abroad. In return, one module of the 5th theory semester and three modules of the 7th theory semester are shifted to the 6th theory semester. To make it easier to find equivalent modules at the partner university abroad, a module from the module group EIT-WP is also selected for this purpose. If the same or similar modules

cannot be found at the foreign university, students can propose alternative modules to the examination board.

Note 1:
The creditability of modules taken at foreign universities must be clarified with the examination board **before** the stay abroad. In favour of the attractiveness of a stay abroad, no 1:1 correspondence with the content of the corresponding modules at TH Rosenheim is required for the crediting of modules from abroad.

Note 2:
The module group of practical courses (EIT-PL) can usually also be taken in Rosenheim during a stay abroad in the 6th semester, as the courses take place either asynchronously online or as block courses in the last two weeks of March before the start of the lecture period of the summer semester. Please inform yourself about this in advance.

Exemplary course of studies with a stay abroad in the 6th semester



Further information:

- Information on studying abroad can be found at International Office
- Information on the recognition of study achievements from abroad can be found at International Office - Recognition of Study Achievements
- The exchange programme of the programme's partner universities can be researched under Partner universities recherchiert werden.
- Information about a semester abroad as a freemover (i.e. outside the university partner-

ships of the faculty) can be found here.

11 Content-related, organisational and contractual dovetailing for dual study programmes

The study programme of the International Bachelor of Engineering according to the Rosenheim study model is particularly suitable as a dual study programme with in-depth practice or as a combined study programme. The learning locations of university and company are systematically interlinked in terms of content, organisation and contract.

Contractual interlocking

Rosenheim Technical University of Applied Sciences provides sample contracts for dual studies that are based on the contract templates of hochschule dual. In particular, rights and obligations as well as agreements on the study and practical phases between the dual practice partners and the dual students are stipulated in these contracts. With the concluded contracts, the prospective students apply for a place at Rosenheim Technical University of Applied Sciences, which also creates a contractual relationship between dual students and the university. Furthermore, the companies conclude a cooperation agreement with Rosenheim Technical University of Applied Sciences, which corresponds to the model of the hochschule dual. More detailed information on this, as well as sample contracts and cooperation agreements, can be found on the website of the university.

Content dovetailing

The course of study for dual students alternates between theoretical content at the university and in-depth study through practical application in the company. The following academic achievements are made in the partner company:

- Internship:
  The internship accompanying the course of study, worth 24 ECTS credits, must be completed in the partner company. Associated practical courses (PLV) can be completed in the partner company for up to 6 ECTS credits if offered.
- Bachelor's thesis:
  The Bachelor's thesis, worth 12 ECTS credits, is completed at the partner company of the dual student. The topic and the content of the work are determined together with the examiners of the Bachelor's thesis at the university.
- Project work:
  To further interlink the learning locations of company and university, the study plan provides for the preparation of three project papers, each worth 5 ECTS credits, i.e. a total of 15 ECTS credits. The project work is done in the partner company of the dual

student. The supervision and examination are carried out by professors at the university, who are selected according to subject-specific criteria. The subject content of a project work is based on the course content of the respective study section in which the project work is carried out and is determined in consultation between the company, students and examiners at the university.

Since the project work “Electronic assemblies”, “System components” and “System integration” are compulsory for non-dual students, there are adapted study plans for dual students. In these plans, the coursework that students complete in their partner company is marked in colour.

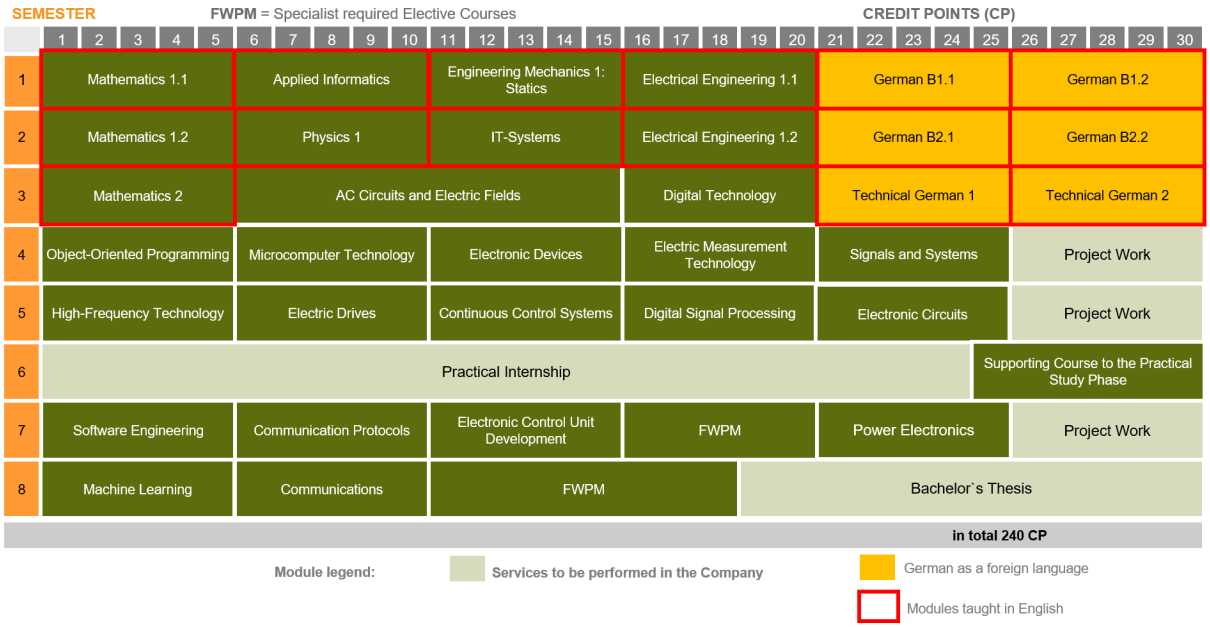


Figure 1: Dual study programme with practical semester, particularly suitable for combined study programmes

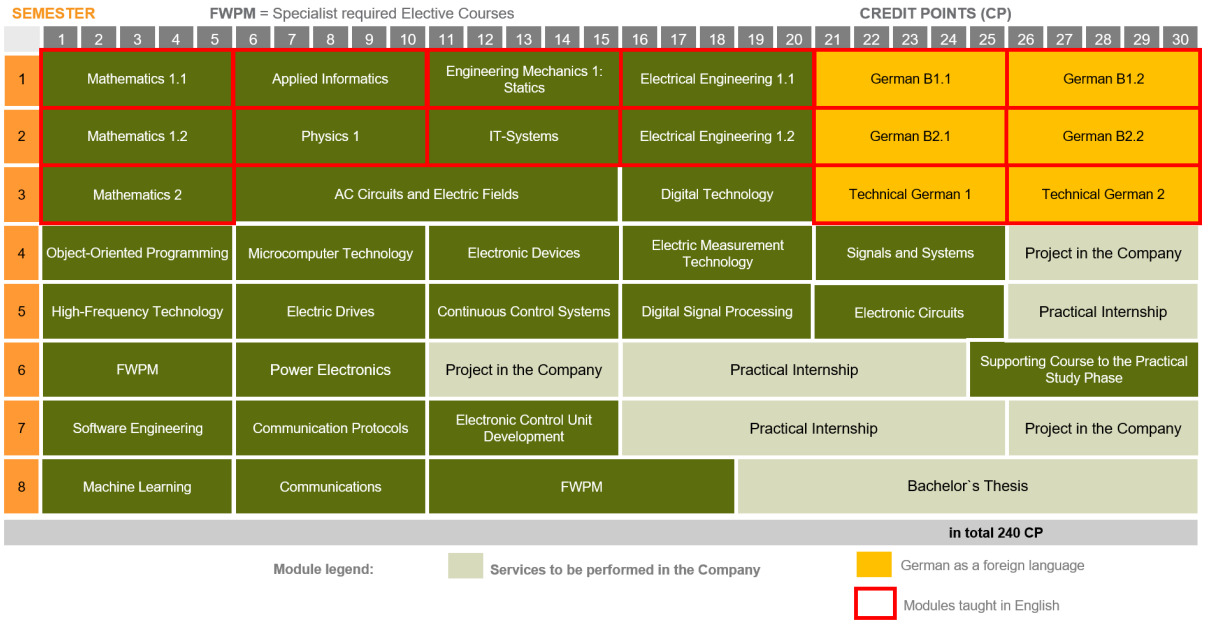


Figure 2: Dual study programme without practical semester, particularly suitable for studies with in-depth practice

Organisational interlocking

The organisational integration of companies and the university takes place in joint committees (university council, industry and business advisory board) and in the working group “Duales Studium”. Further information on this can be obtained from the internship officer of the degree programme.

Information on dual studies for prospective and current students

Prospective and current students can find detailed information about the dual study programme on the university’s website. Information is also provided at information events at the university, e.g. taster days. Prospective students or students can obtain further information from the university’s student advisory service or from the subject-specific student advisory service for the degree programme.

12 Prior knowledge at the start of the programme International Bachelor of Engineering

In the mathematics and physics modules, first-year students on the International Bachelor of Engineering degree programme should have the previous knowledge that corresponds to the teaching content of the technical secondary school. In addition, knowledge of German and English are admission requirements for the degree programme. The following list provides an overview:

Prior knowledge of languages: German language skills at level A2 and English language skills at level B2 according to the CEFR are language admission requirements for the degree programme.

Previous knowledge in mathematics

Elementary algebra
Calculating with brackets, fractions, powers and roots, solving an algebraic equation according to an unknown, solving a quadratic equation

Geometry
Angles in degrees and radians, ray theorems, triangle calculations (Pythagorean theorem, area, angle sum), circle calculations (circumference, area, tangent)

Analytic geometry
Cartesian coordinate system, equation of a straight line and circle, intersection points

Functions
Function definition, function graph, inverse function, polynomial function, power and cube functions, trigonometric functions, exponential and logarithm functions, linear systems of equations with two (three) unknowns.

Vector calculus
Representation of vectors in plane and space, addition and subtraction of vectors Scalar and vector product

Differential and integral calculus
Derivation rules (factor, sum, product, quotient and chain rule), curve discus- sion (zero points, extreme values, turning points, asymptotes), primitive function and main theorem of differential and integral calculus, integration rules

Prior knowledge of physics

Kinematics, Newton’s laws, conservation laws of energy and momentum, description of the simple processes from the previously mentioned areas with the help of differential and integral calculus.

13 Ongoing information

Up-to-date information is provided via the **Learning Campus**, the **Community**, the **timetablesystem** Starplan, via the homepage of the **Electrical Engineering and Information Technology programme** (News) and the showcase at the secretary's office for Electrical and Information Technology (room D1.13a). In particular, the information in the *Learning Campus*, the *Online-Community* and in *StarPlan* must be obtained daily or subscribed to by e-mail..

- **Learning Campus / Community:** Current announcements and documents for the individual courses
- **StarPlan:** view timetables and receive notifications of timetable, room and lecture changes

Organisational matters at the beginning of the semester

To ensure smooth communication between the secretariat, teachers and students, the students elect a semester spokesperson and a deputy semester spokesperson. Both should be reachable by mobile phone.

14 Contact person

Secretariat:

Ms Evelyn Lang
Room D 1.13a
08031 / 805-2720
evelyn.lang@th-rosenheim.de
Office opening hours:
Mon. to Thurs.: 8:00 - 11:00 Friday closed

Programme coordination:

Franziska Wohlfart
Room R 2.22
08031 805- 2843
franziska.wohlfart@th-rosenheim.de

Internship Officer:

Prof. Dr. techn. Norbert Seliger
Room R 2.30
08031 805-2624
norbert.seliger@th-rosenheim.de

Representative of the Examination Commission:

Prof. Dr. rer. nat. Josef Popp Raum R 2.18 08031 / 805-2717 josef.popp@th-rosenheim.de

Dean of Studies:

Prof. Dr.-Ing. Peter Zentgraf
Room D 2.10
08031 805- 2660
peter.zentgraf@th-rosenheim.de

15 Module Descriptions

Version b2614f27 for students
according to the SPO of May, 6th 2022

Module name	German B1.1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR11		1	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Barbara Lembcke	Janika Hausner	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer semester	German / Englisch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

-

Recommended prerequisites

A2 completed according to CEFR

Intended learning objectives

Advanced language use B1.1 according to CEFR
The students can

- understand frequently used expressions and clear standard language relating to study, work and leisure
- cope with most everyday situations in the language area
- express themselves simply and coherently on familiar topics and personal areas of interest
- report on experiences and events
- Describe hopes and goals
- give brief reasons and explanations for plans and views
- use some more complex grammatical structures.

Content
B1.1 (The module comprises parts of level B1) • Teaching and examination focus: Speaking and listening comprehension • Practical language skills for study and everyday life • Presenting and discussing (oral presentation of one's own opinion with brief justification) • Vocabulary (expanding the range of vocabulary for everyday life and study, noun-verb combinations, use of vocabulary in context) • Grammar (perfect / preterite / past perfect, future tense, passive voice, subjunctive II, verbs with prepositions, prepositions, adjective declension, accusative / dative / genitive, connectors and sentence combinations, relative clauses, etc.) • Pronunciation • intercultural competence
Recommended literature
• To be announced in the course

Module name	German B1.2		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR12		1	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Barbara Lembcke	Janika Hausner	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer semester	German / Englisch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

-

Recommended prerequisites

A2 according to GER completed

Intended learning objectives

B1.2 (The module comprises parts of level B1)

- Teaching and examination focus: Writing and reading comprehension
- Practical language skills for study and everyday life
- Emails and written communication
- Written presentation of one's own opinion with brief justification on familiar topics
- Vocabulary (expanding the range of vocabulary for everyday life and study, noun-verb combinations, use of vocabulary in context)
- Grammar (perfect / preterite / past perfect, future tense, passive voice, subjunctive II, verbs with prepositions, prepositions, adjective declension, accusative / dative / genitive, connectors and sentence combinations, relative clauses, etc.)
- intercultural competence

Content
Level B1.2 • Teaching and examination focus: Writing and reading comprehension • Practical language skills for study and everyday life • Mails and written communication • Vocabulary and grammar • Intercultural competence
Recommended literature
• To be announced in the course

Module name	Mathematics 1.1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR13	Maths 1.1	1	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Link	Prof. Dr. Link, Dr. Douka	SU	5
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes
IBE
Mandatory requirements according to examination regulations
none
Recommended prerequisites
General higher education qualification (Abitur), advanced technical college certificate (Fachhochschulreife) or equivalent
Intended learning objectives
The aim is to teach and deepen mathematical basics and their applications. The students are then able to formulate practical problems mathematically and solve them by selecting suitable methods. Due to the knowledge of mathematical basics, the students are able to independently deal with more advanced mathematical methods.
Brief description of the module
The students master the basics of linear algebra and vector calculus. They know the basics of calculus, can confidently deal with functions of a variable and are proficient in differential and integral calculus in a variable. They can handle and apply complex numbers.

Content

Lecture:

- Basics
- Linear algebra
- Differential and integral calculus of a variable
- Introduction to complex numbers

Exercises

Exercises accompanying the lectures

Recommended literature

- G. James, P. Dyke: Modern Engineering Mathematics, Pearson, 6th edn. , 2020
- G. James, P. Dyke: Advanced Modern Engineering Mathematics, Pearson, 4th edn. , 2011
- E. Kreyszig,: Advanced Engineering Mathematics, John Wiley & Sons, 10th edn. , 2011

Module name	Electrical Engineering 1.1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR14	EE1	1	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stubenrauch	Prof. Dr. Stubenrauch, Prof. Dr. Hagl	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

none

Recommended prerequisites

- Physical units and their conversion
- Angular, exponential and logarithmic functions
- Linear systems of equations with several unknowns
- Basic differential and integral calculus

Intended learning objectives

- are confident in the use and conversion of units
- apply modeling techniques in electrical engineering and describe the limited range of model validity
- are familiar with basic electric circuit devices and their voltage/current behavior
- simplify and solve DC circuits in a systematic fashion
- solving linear first order systems in time domain
- know the basic concepts of AC theory and measurements
- and apply computer-aided simulation methods (LTspice) to verify their calculations

Content

- Systems of units
- Basic electrotechnical quantities (charge, voltage, potential, current, work, power, resistance, conductance)
- Electronic components and circuit models (voltage/current source, Resistor, Diode, Transistor)
- Calculation of DC networks with standard methods (Ohm's Law, Kirchhoff's Laws, series- and parallel connection, source transformations, superposition)
- LTspice for simulation and verification of electrical circuits
- Operational amplifier circuits
- Capacitors and Inductors
- Analysis of first order circuits
- Basic AC circuit analysis

Recommended literature

- C. Alexander, M. Sadiku: Fundamentals of Electric Circuits, Mc Graw Hill, 7th Edition, 2020
- J.M. Fiore: DC Electrical Circuit Analysis: A Practical Approach, online available @dissidents (Creative Commons license), 2022, http://www.dissidents.com/books.htm

Module name	Applied Informatics		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR15	AppInf	1	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Klein	Prof. Dr. Klein	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

none

Recommended prerequisites

none

Intended learning objectives

After successful participation in the course, students are able to

- Understand the basic functioning of a computer
- Understand the computer's internal number representation and use the correct basic data types.
- produce programmes of medium complexity using control structures and functions and observing quality criteria (readability, maintainability and reusability).
- Design and implement algorithms
- use the version management tool Git
- use the C standard library
- analyse and evaluate other people's source code

Brief description of the module

The students learn the basics of procedural programming using the C language. In this context, the basics of computer architecture including memory model and data types are also taught. After successful participation, the students are able to design algorithms and implement programmes using control structures, functions and observing quality criteria.

Content

- Introduction to computer architecture and memory model
- Number systems, coding
- Basic data types and arrays
- Version management using Git
- Control structures
- Functions
- Arithmetic, bitwise and Boolean operators
- C standard library

Recommended literature

- B. Kernighan, D. Ritchie: Programmieren in C. ANSI C, Carl Hanser, 2.Auflage, 1990
- H. Erlenkötter: C:Programmieren von Anfang an, Rowohlt Taschenbuch, 25.Auflage, 1999
- A. Böttcher, F. Kneißl: Informatik für Ingenieure, Oldenbourg Verlag, 3.Auflage, 2012

Module name	Engineering Mechanics 1: Statics		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR16	Statics	1	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Schinagl, Prof. Dr. Wagner	Prof. Dr. Schinagl, Prof. Dr. Wagner	SU, Ü	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

none

Recommended prerequisites

Knowledge of mathematics and physics according to the contents of the FOS-Technology course or the Abitur (A-levels).

Intended learning objectives

After successful participation in the module courses, students are able to

- apply engineering-recognised methods of rigid-body statics to analyse technical components and assemblies under point and distributed loads with regard to internal and external forces, moments and their local curves.
- structure practical technical-mechanical systems.
- use the mathematical relationships generated with it for calculations.
- understand important special cases and apply the methods learned to them.
- document the methodical procedure for solving problems from structural analysis in a form-appropriate and comprehensible manner.

Brief description of the module

The course “Statics” is the first and essential part of technical mechanics. Here, the basics and methods for the calculation of internal and external forces and moments on static single and multi-body systems are taught. These basics are based on the equilibrium of forces and moments, which leads to mathematical equations and their solution via the free-cutting method. Important special cases, such as surface or wrap-around friction or distributed loads, are taken into account. Statics forms the basis for many other engineering fields and teaching modules.

Content

- Terms, basic laws, basic tasks of statics
- Central, plane force system
- Force, force couple and moment of a force
- Resultant force of a non-central planar force system
- Stock reactions
- Spatial force system
- Focus
- Internal forces and moments, internal force curves also under distributed loads
- Friction

Recommended literature

- Skript and Formulary
- M.Mayer: Technische Mechanik, Carl Hanser, 9th Edition, 2021
- D.Gross, W.Hauger, J.Schröder, W.A.Wall: Technische Mechanik 1:Statik, Springer Vieweg, 14th Edition, 2019
- C. Eller: Holzmann/Meyer/Schumpich Technische Mechanik Statik, Springer Vieweg, 15th Edition, 2018
- R.C. Hibbeler: Engeneering Mechanics: Statics, Pearson, 15th Edition, 2022
- D. Gross et. Al.: Statics – Formulas and Problems: Engineering Mechanics 1, Springer, 1st Edition, 2022

Module name	German B2.1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR21		2	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Barbara Lembcke	Frau Hausner	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Winter semester	German / English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

-

Recommended prerequisites

B1 according to GER completed

Intended learning objectives

Independent use of language B2 according to CEFR
The students can

- understand the main content of complex texts on concrete and abstract topics and on specialist discussions in their own area of specialisation
- communicate so spontaneously and fluently that a conversation with native speakers is possible without major effort on either side
- express themselves on a wide range of topics
- explain a point of view on a topical issue and state the advantages and disadvantages of various options.

Students have all the essential grammatical knowledge of the target language.

Content
B2.1 (The module comprises parts of level B2) • Teaching and examination focus: Speaking and listening comprehension • Practical language skills for study and everyday life • Presenting and discussing (detailed explanation of one's own point of view with advantages and disadvantages on current topics) • Description and brief interpretation of graphs and other charts • Vocabulary (deepening the known vocabulary spectrum and expanding it to include a subject-specific and a broad general range of topics, context-safe use, variation in language and expression) • Grammar (verbs, nouns and adjectives with prepositions, passive voice, connectors and conjunctions, subjunctive I and II, subjective meaning of modal verbs, etc. - precise use of all essential grammar structures in context) • Pronunciation • intercultural competence
Recommended literature
• To be announced in the course

Module name	German B2.2		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR22		2	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Barbara Lembcke	Frau Hausner	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Winter semester	German / English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

-

Recommended prerequisites

B1 according to GER completed

Intended learning objectives

Independent use of language B2 according to CEFR
The students can

- understand the main content of complex texts on concrete and abstract topics and on specialist discussions in their own area of specialisation
- communicate so spontaneously and fluently that a conversation with native speakers is possible without major effort on either side
- express themselves on a wide range of topics
- explain a point of view on a topical issue and state the advantages and disadvantages of various options

Students have all the essential grammatical knowledge of the target language.

Content
B2.2 (The module comprises parts of level B2) • Teaching and examination focus: Writing and reading comprehension • Practical language skills for study and everyday life • Writing a graphic analysis and a short discussion • Vocabulary (deepening the known vocabulary spectrum and expanding it to include a subject-specific and a broad general range of topics, context-safe use, variation in language and expression) • Grammar (verbs, nouns and adjectives with prepositions, passive voice, connectors and conjunctions, subjunctive I and II, subjective meaning of modal verbs, etc. - precise use of all essential grammar structures in context) • intercultural competence
Recommended literature
• To be announced in the course

Module name	Mathematics 1.2		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR23	Maths 1.2	2	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Link	Prof. Dr. Link, Dr. Douka	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Winter Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes
IBE
Mandatory requirements according to examination regulations
none
Recommended prerequisites
General higher education qualification (Abitur), advanced technical college certificate (Fachhochschulreife) or equivalent
Intended learning objectives
The aim is to teach and deepen mathematical basics and their applications. The students are then able to formulate practical problems mathematically and solve them by selecting suitable methods. Due to the knowledge of mathematical basics, the students are able to independently deal with more advanced mathematical methods.
Brief description of the module
The students master the basics of linear algebra and vector calculus. They know the basics of analysis, can confidently deal with functions in several variables and are proficient in differential and integral calculus in several variables. Furthermore, the students are able to apply the basic integral transformations and the corresponding inverse transformations to elementary functions.

Content

Lecture:

- Basics
- Linear algebra
- Differential and integral calculus in several variables
- Integral transformations

Exercises

Exercises accompanying the lectures

Recommended literature

- G. James, P. Dyke: Modern Engineering Mathematics, Pearson, 6th edn. , 2020
- G. James, P. Dyke: Advanced Modern Engineering Mathematics, Pearson, 4th edn. , 2011
- E. Kreyszig,: Advanced Engineering Mathematics, John Wiley & Sons, 10th edn. , 2011

Module name	Physics 1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR24	Physics 1	2	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stanzel	Prof. Dr. Stanzel	SU,Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Winter Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	56 h	70 h	24 h

Applicability of the module in the degree programmes
In IBE
Mandatory requirements according to examination regulations
none
Recommended prerequisites

Mathematics and science school education:

- Knowledge of vector calculus (understanding the meaning of scalar and vector product)
- Be able to carry out a curve discussion of simple functions
- Understand the meaning of integration and differentiation of simple functions, be able to perform differentiation and integration of simple functions.
- Understand and calculate exponential and logarithm functions
- Understand and calculate trigonometric functions (sin, cos, tan)
- Be able to solve linear and quadratic equations

Intended learning objectives

After successful participation in the seminar-based teaching, students will be able to …

- Calculate safely with physical quantities and units including prefixes and powers and include them in all calculations.
- Understand and confidently apply the basic kinematic relationships between displacement, velocity and acceleration in translation and circular motion.
- Define the fundamental concept of force and describe the types of force.
- Use Newton's laws confidently and understand them as an important tool in solving problems.
- Understand and distinguish between the concepts of work, energy and power and apply the mechanical law of conservation of energy when solving problems.
- Set up the equation of motion of the one-mass oscillator for the free, damped and forced case and to discuss and interpret the different solution.
- Get to know different forms and realisations of oscillatory systems including damping and excitation mechanisms.
- Understand the phenomenon of resonance in forced oscillation in particular and understand and interpret the meaning of the amplitude resonance curve (amplitude frequency response).
- Name and distinguish thermal state and process variables.
- Calculate changes of state of the ideal gas and reproduce them in p-V diagrams.
- Name the main laws of thermodynamics and apply them to the evaluation and calculation of thermal processes.
- Safely consider heat capacities, phase transformations and heat transport mechanisms in calculations.
- Comprehend the principle of thermal plants based on circular processes.

Furthermore, after successful completion of the internship, students are able to …

- Independently understand the physical relationships in the context of the subject area.
- Perform uncertainty assessments safely.
- Plan experiments and record measurement data as well as evaluate, critically question and scientifically document the results obtained.
- Support each other through teamwork and to have professional discussions.

Brief description of the module

The module consisted of the blocks Size Units Uncertainty Test, Kinematics, Dynamics 1 (Translation), Vibration and Fundamentals of Thermodynamics. Accompanying the lecture, practical experiments are carried out for the subject area of quantities - units - uncertainty - experiment, for the understanding of the kinematic quantities velocity and acceleration as well as for the understanding of mechanical resonance and thermodynamics.

Content
Quantities, units, measurement and evaluation Physical quantities, units, orders of magnitude, significant digits, measurement uncertainties, calculating with uncertainties, compensation line, linearisation **Kinematics** Definition and relationship of displacement, velocity and acceleration as vectorial quantities, special cases: rectilinear and circular motion **Dynamics 1** Concept of force and Newton's axioms, examples of forces, work, energy, power, efficiency, mechanical law of conservation of energy **Oscillations** Setting up the equation of motion of the single-mass oscillator for the free, damped and forced case including discussion and interpretation of the solution, examples of oscillatory systems including damping and excitation mechanisms, resonance, amplitude resonance curve (amplitude frequency response), phase shift (phase frequency response). **Basics of thermodynamics** Thermal state and process variables, heat capacity, ideal gas, main laws of thermodynamics, cyclic processes, phase transformations, heat transport
Recommended literature
• P. A. Tipler, G. Mosca: Physics for Scientists and Engineers, W. H. Freeman, 6. Auflage , 2007

Module name	Electrical Engineering 1.2		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR25.2	EE1.2	2	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stahl	Prof. Dr. Stahl	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Winter Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

none

Recommended prerequisites

Contents of the module IBE 14 (Electrical Engineering 1.1)

Intended learning objectives

After successfully completing the module, students are able to:

- calculate the AC behavior of circuits,
- interpret the complex AC calculation for sinusoidal signals of a certain frequency,
- determine voltages, currents, and power values in RL und RC circuits, and in resonant RLC networks.

Brief description of the module

Based on the module IBE14 (Electrical Engineering 1.1), the complex calculation of AC circuits is introduced

Content

- Periodic / sinusodial Signals, Frequency
- Calculation of AC Quantities: Voltage / Current, Power, Energy, Effective values
- Introduction of complex Calculation of sinusodial Voltages and Currents using complex exponential Oscillations
- Complex calculation of Active, Reactive and Apparent Power
- Calculation of RC and LC Filters
- Calculation of RLC Circuits and resonant Circuits
- Basic Observation of Frequency Responses in a Bode Diagram
- Fundamental Principle of the Fourier Analysis of periodic Signals
- Magnetic Circuit and Transformers
- Lab Exercises, Practical Simulation Exercises

Recommended literature

- H. Stahl: Electrical Engineering – AC Circuit Analysis, Handout for the lecture, TH Rosenheim
- J.M. Fiore: DC Electrical Circuit Analysis: A Practical Approach, online available @dissidents (Creative Commons license), 2023, http://www.dissidents.com/books.htm
- J.M. Fiore: AC Electrical Circuit Analysis: A Practical Approach, online available @dissidents (Creative Commons license), 2023, http://www.dissidents.com/books.htm

Module name	IT Systems		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR25.6	IT	2	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. M.Tilly	Prof. Dr. M.Tilly	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Winter Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes
Applied Artificial Intelligence Bachelor
Mandatory requirements according to examination regulations
none
Recommended prerequisites
Intended learning objectives
Students know architecture and processor alternatives of modern computer systems and can assess how individual aspects of the architecture can influence the performance of a system. Students can use modern operating systems and apply them effectively. They can explain how data is communicated between systems and they are able to explain how packet-switching systems work. Students know the concept of protocols and layers and know how to assign individual data communication tasks to the correct layers. They can explain which technologies are used in the local network and the Internet and can use them in their own applications. Furthermore, students can explain the technical basics of Internet technologies and assess which effects and possibilities they have in companies.

Brief description of the module

This module teaches the basis of IT systems from individual computers to distributed systems in the cloud. The focus is on practical application and programming. Based on the von-Neumann computer architecture, the basic structure and functioning of a computer are explained. The students learn the basics of circuit networks and the logical structure of a computer. The basic interaction of the various components in a computer is taught and tested.Furthermore, how different operating systems work on IT systems, i.e. how they handle resources and execute programs. The focus is on shell commands and the implementation in corresponding batch processing programs. In addition to the basics, an overview of different processor architectures is also provided (e.g. x86 vs. ARM). Since today's IT systems are rarely local single-computer systems, it is worth taking a look at distributed systems and computer networks. Thus the basics of network and internet technologies are examined. The students learn about the basic technologies of the Internet and how to use them in their own applications. They gain an understanding of the technical structure of web applications and learn to implement simple web applications. The students also get to know and use modern cloud systems and technologies

Content

1. Basics of hardware concepts and computer architectures (von-Neumann Architecture)
2. Logical design of computers and switching networks
3. Computer structures, bus concepts, arithmetic logic unit, control unit, memory, input/output
4. Introduction to processor architecture with examples of x86 and ARM
5. Introduction to operating systems using examples of Windows and Linux
6. Networks
7. Distributed applications
8. Internet technologies: protocols, concepts and architectures
9. Basic technologies of the World Wide Web (WWW)
10. Concepts and realisation of web applications
11. Cloud architectures/technologies

Recommended literature

- A. Tanenbaum: Computer Networks, Pearson, 5.Edition 2013
- A. Sunyaev: Internet Computing: Principles of Distributed Systems and Emerging Internet-Based Technologies, Springer, 1.Edition, 2020
- J. Ledin: Modern Computer Architecture and Organization, Packt Publishing, 2.Edition, 2022
- A. Tanenbaum, J. Goodman: Structured Computer Organization, Person Prentice Hall, 5.Edition, 2006
- S. Tilkov: REST und HTTP, dpunkt Verlag, 1. Edition, 2015

Module name	Technical German 1 – B2/C1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR31		3	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Barbara Lembcke	Frau Hausner	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer Semester	German / English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

-

Recommended prerequisites

Level B2 according to CEFR or higher

Intended learning objectives

Specialised language use level B2/C1 according to CEFR
The students can

- understand a wide range of demanding texts
- express themselves spontaneously and fluently without often having to search for clearly recognisable words
- use the language in your studies, social and professional life
- express themselves clearly and in a structured way on complex issues, using various means to link texts.

Content

- Practical language skills for studying
- Oral examination forms in German
- Technical German for engineers
- Grammar
- Vocabulary
- Presenting and discussing
- Pronunciation
- intercultural competence

Recommended literature

- M. Steinmetz, H. Dintera: German for Engineers, Springer Vieweg, 2nd edition, 2018
- Further materials will be announced during the course

Module name	Technical German 2 – B2/C1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR32		3	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Barbara Lembcke	Frau Hausner	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Summer Semester	German / English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes

IBE

Mandatory requirements according to examination regulations

-

Recommended prerequisites

Level B2 according to CEFR or higher

Intended learning objectives

Specialised language use level B2/C1 according to CEFR
The students can

- understand a wide range of demanding texts
- express themselves spontaneously and fluently without often having to search for clearly recognisable words
- use the language in your studies, social and professional life
- express themselves clearly and in a structured way on complex issues, using various means to link texts.

Content

- Practical language skills for studying
- Written examination forms in German
- German for engineers
- Writing an internship report
- Grammar
- Vocabulary
- intercultural competence

Recommended literature

- M. Steinmetz, H. Dintera: German for Engineers, Springer Vieweg, 2nd edition, 2018
- Further materials will be announced in the course

Module name	Mathematics 2		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR33	Maths 2	3	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Link	Prof. Dr. Link, Dr. Douka	SU	4
Form of examination	**Module duration**	**Module rotation**	**Language**
see SPO	1 Semester	Summer Semester	English
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes
IBE
Mandatory requirements according to examination regulations
none
Recommended prerequisites
General higher education qualification (Abitur), advanced technical college certificate (Fachhochschulreife) or equivalent
Intended learning objectives
The aim is to teach and deepen mathematical basics and their applications. The students are then able to formulate practical problems mathematically and solve them by selecting suitable methods. Due to the knowledge of mathematical basics, the students are able to independently deal with more advanced mathematical methods.
Brief description of the module
The students master the basics of vector analysis and can apply them to simple problems. They can solve ordinary differential equations of first and second order. Furthermore, the students are able to apply the basic integral transformations and the associated inverse transformations to elementary functions. They know the basics of numerical mathematics and can apply them to simple problems.

Content

Lecture:

- Vector analysis
- Differential equations
- Integral transformations
- Fundamentals of numerical mathematics

Exercises

Exercises accompanying the lectures

Recommended literature

- G. James, P. Dyke: Modern Engineering Mathematics, Pearson, 6th edn. , 2020
- G. James, P. Dyke: Advanced Modern Engineering Mathematics, Pearson, 4th edn. , 2011
- E. Kreyszig,: Advanced Engineering Mathematics, John Wiley & Sons, 10th edn. , 2011

Module name	Digitaltechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR25.13	DiTe	2, IBE 3	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Versen	Prof. Dr. Versen, Hr. Kolb	SU, Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	60 h	30 h

Applicability of the module in the degree programmes
EIT, MEC
Mandatory requirements according to examination regulations
keine
Recommended prerequisites
Informatik Grundlagen
Intended learning objectives
Die Studierenden erhalten Kompetenzen, digitale Schaltungen und endliche Zustandsautomaten zu entwerfen, zu realisieren und zu testen. Die Studierenden haben nach der Lehrveranstaltung fachspezifische Kenntnisse über die Grundlagen, die Analyse und Synthese von digitalen Schaltungen und endlichen Zustandsautomaten.
Brief description of the module
Im Modul Digitaltechnik lernen die Studierenden die Grundlagen und Komponenten von digitalen Schaltungen kennen, die in eingebetteten Systemen vorkommen

Content

Vorlesung:

- Einführung, Festkommaarithmetik im Dualsystem
- Schaltalgebra
- Verhalten logischer Gatter, Wellenleitung
- Schaltungstechnik
- Minimierung von schaltalgebraischen Funktionen
- Asynchrone Schaltwerke, FlipFlops, Zähler
- Synchrone Schaltwerke

Praktikum:

- Ansteuerung eines Schrittmotors
- Aufbau unterschiedlicher Zählschaltungen
- Datenspeicherung in RAM und ROM
- Kommunikation mit einem seriellen Interface

Recommended literature

- K. Fricke: Digitaltechnik, Springer Vieweg, 9.Auflage, 2021
- J. Reichardt, B. Schwarz: VHDL Synthese, De Gruyter, 7.Auflage, 2015
- W. Roddeck: Einführung in die Mechatronik, Springer Vieweg, 6.Auflage, 2019
- H.U. Seidel, E. Wagner: Allgemeine Elektrotechnik:Wechselstromtechnik - Ausgleichsvorgänge - Leitungen, Band 2, Carl Hanser, 3.Auflage, 2006

Module name	Wechselstrom- und Feldlehre		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
IBR25.14	WuF	2, IBE 3	10
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Popp	Prof. Dr. Popp	SU, Ü, Pr	9
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
300 h	150 h	90 h	60 h

Applicability of the module in the degree programmes

EIT, MEC

Mandatory requirements according to examination regulations

PmE

Recommended prerequisites

Gleichstromlehre, Grundlagen der Wechselstromlehre, komplexe Zahlen

Intended learning objectives

Die Studierenden:

- berechnen umfangreichere lineare Netzwerke bei sinusförmigem Wechselstrom frequenzabhängig;
- interpretieren die wichtigsten Feldgrößen der Elektrotechnik anschaulich und beschreiben den Zusammenhang mit Klemmengrößen mathematisch;
- führen typische Dimensionierungsaufgaben für Elektromagnete oder Transformatoren durch;
- wählen geeignete Berechnungsmethoden aus und wenden diese sicher an.

Brief description of the module

Vertiefung komplexer Wechselstromlehre, Frequenzabhängige Netzwerke und komplette Feldlehre

Content

- Drehstrom
- Frequenzabhängige Netzwerke, Übertragungsfunktion, Vierpoltheorie und Bodediagramm
- Elektrisches Strömungsfeld
- Elektrisches Feld und Potential
- Kondensatoren und Materialeigenschaften
- Magnetisches Feld, Materialeigenschaften und Eisenkreise
- Induktion und Transformator
- Maxwellsche Gleichungen

Recommended literature

- A. Führer, K. Heidemann, W. Nerreter: Grundgebiete der Elektrotechnik 1: Stationäre Vorgänge, Carl Hanser Verlag, 10.Auflage, 2019
- A. Führer, K. Heidemann, W. Nerreter: Grundgebiete der Elektrotechnik 2: Zeitabhängige Vorgänge, Carl Hanser Verlag, 10.Auflage, 2019
- H. Clausert, G. Wiesemann: Grundgebiete der Elektrotechnik 1 + 2, deGruyter, 12.Auflage, 2015
- T. Harriehausen, D. Schwarzenau: Moeller Grundlagen der Elektrotechnik, Springer und Vieweg, 24.Auflage, 2020

Module name	Objektorientierte Programmierung		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT31	OOP	3, IBE 4	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Michael Helbig	Prof. Dr. Michael Helbig	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

EIT, MB, MEC, MT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Ingenieurinformatik Grundlagen, Hardwarenahe Programmierung

Intended learning objectives

Nach erfolgreicher Teilnahme an der Lehrveranstaltung sind die Studierenden in der Lage

- die Grundprinzipien der objektorientierten Programmierung zu verstehen.
- eigenständig objektorientierte Software zu entwerfen und zu implementieren.
- fremde objektorientierte Implementierungen zu verstehen und zu diskutieren.
- eigenständig Probleme zu analysieren und strukturierte objektorientierte Software zu erarbeiten

Brief description of the module

- Die Studierenden lernen die Konzepte der objektorientierten Programmierung.
- Nach erfolgreicher Teilnahme können Studierende eigenständig Probleme objektorientiert strukturieren, modellieren und implementieren.

Content

- Objekte und Klassen
- Typen und Variablen
- Kontrollstrukturen
- Konstruktoren und Methoden
- lokale Variablen, Attribute und statische Attribute
- Datenkapselung und Sichtbarkeit von Attributen und Methoden
- Arrays und Listen
- Vererbung und abstrakte Klassen
- Interfaces
- Generics
- Exceptions

Recommended literature

- C. Ullenboom: Java ist auch eine Insel, Rheinwerk Computing, 15. Auflage, 2021
- B. Lahres, G. Rayman: Objektorientierte Programmierung, Rheinwerk Computing, 2. Auflage, 2009

Module name	Mikrocomputertechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT32	MC	3, IBE 4	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Versen	Prof. Dr. Versen	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

EIT, IBE

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Ingenieurinformatik Grundlagen, Hardwarenahe Programmierung

Intended learning objectives

Die Studierenden sind nach erfolgreichem bestehen in der Lage:

- die Architektur und grundlegende Funktionsweise moderner Mikroprozessoren und Mikrocontroller zu verstehen.
- Assemblerprogramme mit Unterprogrammen für den ARM-Befehlssatz zu verstehen und zu entwickeln.
- Software für einen modernen Mikrocontroller und dessen Peripheriefunktionen in Assembler und C zu entwickeln.
- mit technischen Dokumentationen wie englischsprachigen Datenblättern umzugehen

Brief description of the module

Das Modul Mikrocomputertechnik lehrt die grundlegende Funktionsweise einer modernen Mikrocontrollerarchitektur und deren Peripherie. Die Studierenden entwickeln im Rahmen des Praktikums Ihr eigenes Hardware Abstraction Layer in Assembler und C, um so die Konfigurationsmöglichkeiten und Peripheriefunktionen zu verstehen und zu verwenden.

Content

- Architektur des MSP430 und des ARM Cortex-M Prozessors, Funktionseinheiten, Registersatz, Pipeline und Speicherorganisation
- Adressierungsarten, Datentypen, Befehlsformat
- ARM-Befehlssatz, Assembler-Programmstruktur und Assembler-Direktiven
- Unterprogrammaufrufe auf Assemblerebene und von C, Stackoperationen
- Exceptions und Interruptverarbeitung
- Peripherie: GPIO, Timer, WatchDog, ADC, I2C, UART und SPI

Recommended literature

- J. Yiu: The Definitive Guide to the ARM Cortex-M3, Elsevier/Newnes, 3.Auflage, 2013
- Y. Zhu: Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC, 3. Auflage, 2017
- ARM Ltd.: An Introduction to the ARM Cortex-M Processor, ARM Ltd, 2006
- J.Davies: MSP430 Microcontroller Basics, Newnes, 2008
- Matthias Sturm: Mikrocontrollertechnik, Hanser, 2014
- D. Simon: Embedded Software Primer, Addison Wesley, 1999
- Diverse Datenblätter, Reference Manuals und Application Notes von ST Microelectronics und Texas Instruments

Module name	Elektronische Bauelemente		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT33	BE	3 , IBE 4	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Popp	Prof. Dr. Popp	SU,Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	75 h	45 h	30 h

Applicability of the module in the degree programmes

EIT, MEC

Mandatory requirements according to examination regulations

Praktikum mit Erfolg abgelegt

Recommended prerequisites

Grundlagen der Gleich- und Wechselstromlehre, Vierpole, Feldlehre

Intended learning objectives

Die Studierenden:

- können grundsätzlich die Funktionsweise und Eigenschaften verschiedener elektronischer Halbleiter-Bauelemente erklären;
- kennen und bestimmen die wichtigsten Parameter zur Modellbildung für Netzwerkanalyse-Programme (SPICE);
- erproben verschiedene Anwendungen elektronischer Bauelemente, z.B. Verstärkerschaltungen;
- dimensionieren ausgewählte Schaltungen und berechnen sowohl stationäre als auch dynamische Eigenschaften.

Brief description of the module

Vertiefung komplexer Wechselstromlehre, Frequenzabhängige Netzwerke und komplette Feldlehre

Content

- Passive Bauelemente
- pn-Übergang
- Halbleiterbauelemente (Dioden, Bipolar- und Feldeffekt-Transistoren)
- SPICE
- Exemplarische Anwendungen

Recommended literature

- M. Reisch: Elektronische Bauelemente, Springer Verlag, Auflage 2 , 2007

Module name	Elektrische Messtechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT34	Elk.MT	3, IBE 4	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Winter	Prof. Dr. Winter	SU, Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	75 h	45 h	30 h

Applicability of the module in the degree programmes

EIT, MB, MEC, MT

Recommended prerequisites

Mathematik, Grundlagen der Elektrotechnik

Intended learning objectives

Nach erfolgreicher Teilnahme sind die Studierenden in der Lage:

- die Funktionsweise und Anwendung von Sensoren u. A. für Weg- und Winkelmessungen, für mechanische Belastungsgrößen sowie für Durchfluss und Temperatur zu beschreiben;
- die Prinzipien von DC - OPV Schaltungen, von ADCs und DACs und von Digitalmultimetern zu beschreiben;
- die diskrete Fouriertransformation (DFT) zur Bestimmung von Amplitudenspektren anzuwenden;
- die Auswirkung von statistischen Messunsicherheiten (Normalverteilung, Fehlerfortpflanzung, Vertrauensintervalle für Erwartungswerte) zu analysieren.

Brief description of the module

Im Modul „Elektrische Messtechnik“ werden vertiefte Kenntnisse zu Widerstandsschaltungen und Messbrücken, Operationsverstärkerschaltungen, Messoszillatoren, Multimetern, Sensoren, Analog-Digitalwandlern und Digital-Analogwandlern, zur digitalen Messtechnik, zur Spektralanalyse periodischer Signale und Statistik vermittelt.

Content

Seminaristischer Unterricht:

- Einführung in die elektrische Messtechnik
- Widerstandsschaltungen und Messbrücken
- Operationsverstärker und Operationsverstärkerschaltungen
- Messoszillatoren
- Multimeter
- Sensoren
- Analog-Digitalwandler (ADCs) und Digital-Analogwandler (DACs)
- Digitale Messtechnik
- Spektralanalyse periodischer Signale mit der diskreten Fouriertransformation
- Messgenauigkeit und Statistik

Praktikum:

- Programmierung eines Arduinos und Auswertung eines Sensorsignals mit Hilfe der diskreten Fouriertransformation
- Stufenweiser Aufbau einer Operationsverstärkerschaltung zur Auswertung einer Waage
- Vermessung der einzelnen Module eines Digitalmultimeters
- Automatische Ansteuerung und Vermessung eines Bandbass-Filters
- Automatische Ansteuerung und Vermessung eines inkrementalen Drehgebers

Recommended literature

- E. Schrüfer, L. Reindl, B. Zagar: Elektrische Messtechnik, Carl Hanser, 12.Auflage, 2018
- T. Mühl: Einführung in die elektrische Messtechnik, Springer Vieweg, 4.Auflage, 2014
- Skript zur Vorlesung

Module name	Signale und Systeme		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT35	SigSys	3, IBE 4	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stahl	Prof. Dr. Stahl	SU,Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	75 h	43 h	32 h

Applicability of the module in the degree programmes

EIT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Mathematik 1 und 2, Gleich- und elementare Wechselstromlehre, Wechselstrom- und Feldlehre,Grundkenntnisse in C und MATLAB

Intended learning objectives

Die Studierenden:

- beschreiben zeitkontinuierliche Signale im Zeit- und im Spektralbereich
- wenden in Abhängigkeit von den Eigenschaften des Signals (Periodizität, Begrenzung der Leistung/Energie) die jeweils in Frage kommenden Spektraltransformationen an
- wählen geeignete Methoden zur Beschreibung von Signalen und Systemen im Zeit- und Frequenzbereich aus und wenden sie sicher an
- bewerten die Eigenschaften grundlegender Systeme zur Signalverarbeitung wie lineare Filter, Abtaster und Modulatoren, und beurteilen, welchen Einfluss diese Systeme auf das Signal und dessen Spektrum haben
- analysieren und strukturieren technische Probleme, beispielsweise bei der Digitalisierung, Verarbeitung & Rekonstruktion analoger Audiosignale unter Einhaltung des Abtasttheorems
- wenden die mathematisch - naturwissenschaftlichen Grundlagen wie die Fourier und Laplace Transformation sicher an.

Brief description of the module

Dieses Modul behandelt Signale und Systeme im Zeit- und Frequenzbereich mittels zeitkontinuierlicher Fourierreihe-, Fouriertransformation und Laplace-Transformation

Content

- Signale und Systeme im Zeit- und Frequenzbereich
- Zeitkontinuierliche Fourierreihe und Fouriertransformation
- Laplace-Transformation
- Signalabtastung und Rückgewinnung

Recommended literature

- M. Werner: Signale und Systeme, Vieweg & Teubner Verlag, 3.Auflage, 2008
- A. Oppenheim, A. Willsky: Signals and Systems: Pearson New International Edition, Pearson Education Limited, 2.Auflage, 2013
- H. Schneider-Obermann: Basiswissen der Elektro-, Digital- und Informationstechnik: Für Informatiker, Elektrotechniker und Maschinenbauer, Vieweg & Teubner Verlag, 1.Auflage, 2006
- O. Mildenberg: System- und Signaltheorie: Grundlagen für das informationstechnische Studium, Vieweg & Teubner Verlag, 3.Auflage, 1995
- B. Girod, R. Rabenstein, A. Stenger: Einführung in die Systemtheorie: Signale und Systeme in der Elektrotechnik und Informationstechnik, Vieweg & Teubner Verlag, 4.Auflage, 2007

Module name	Projektarbeit “Elektronische Baugruppen”		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT3-P	ProjA1	3, IBE 4	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Studiendekan	Professoren der Fakultät	PA	-
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	90 h	0 h

Applicability of the module in the degree programmes

EIT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Alle regulären Module der ersten 2 Semester + parallele Teilnahme an allen regulären Modulen des 3. Semesters

Intended learning objectives

Die Teilnahme an diesem Projektmodul versetzt die Studierenden in die Lage

- elektronische Schaltungen zu entwickeln und zu programmieren,
- und damit das bislang erworbene Fachwissen zu vertiefen und methodisch anzuwenden,
- Methoden des Projektmanagements („agil“ oder „klassisch)“ zu verstehen und zu bewerten,
- und im Nachgang die Qualität und mögliche Fehler beim Projektverlauf zu analysieren und zu benennen.

Brief description of the module

Dieses Modul bildet den ersten Teil von drei aufeinander aufbauenden Projektarbeiten. In jedem der drei Teile soll – in sich abgeschlossen – gemeinsam mit den Studierenden ein eigenes Arbeitsziel definiert werden, das die Teilnehmer dann in kleinen Gruppen unter Anleitung eines Professors weitgehend selbständig bearbeiten. Bei der Bewertung des Moduls in Form einer Prüfungsstudienarbeit wird die Qualität der Arbeitsleistung des Studierenden an dem Projektziel gemessen. Im ersten Teil werden Baugruppen erstellt, die typischerweise aus Hard- und Softwareanteilen bestehen.

Content
In den Semestern 1 bis 3 werden ingenieurwissenschaftliche Grundlagen gelehrt. Inhalte der ersten Projektarbeit Elektronische Baugruppen könnten beispielsweise sein: • Mitarbeit an der Konzeptidee für ein Gerät oder ein komplexeres System • Entwurf einer elektronischen Schaltung, die typischerweise Sensordaten erfasst, Aktoren ansteuert, und/oder mit ihrer Außenwelt kommunizieren kann • Aufbau dieser Schaltung auf einer Leiterplatte und Vermessen der Schaltung • Erstellung von Software zum Testen der Schaltung
Recommended literature
• Wird aktuell bekanntgegeben

Module name	Kommunikationsprotokolle		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT41	KomPro	6, IBE 7	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stahl	Prof. Dr. Stahl	SU,Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	75 h	45 h	30 h

Applicability of the module in the degree programmes

EIT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Modul Signale und Systeme

Intended learning objectives

Die Teilnehmer kennen die Grundlagen der Kommunikationsmechanismen im Internet und im Internet-of-Things. Sie gestalten einfache Anwendungsprogramme auf der Basis des MQTT-Protokolls mit TCP/IP-Sockets, kennen IP-Telefonie sowie Mobilfunkstandards unterschiedlicher Generationen, und klassifizieren und diskutieren die Eignung der Mobilfunkstandards für bestimmte Anwendungsfälle. Sie vermessen bei Mobilfunksystemen die Signale an der Luftschnittstelle, um die verwendeten Protokolle zu erkunden; sie stufen Begrifflichkeiten rund um das Internet der Dinge (IoT) sachlich ein.

Brief description of the module

Die Studierenden erhalten Fähigkeiten in:

- Fachspezifischen Grundlagen: Sie ermitteln die Kanalkapazität eines Mediums mittels des Gesetzes von Shannon-Hartley und können einen guten Leitungscode für dieses Medium auswählen.
- Logischem, analytischem und konzeptionellem Denken: Bei der Protokollanalyse entdecken sie Fehler in einem Rechnernetz.
- Der Auswahl geeigneter Methoden: Sie wenden eine geeignete CRC-Codierung zur Fehlersicherung eines Übertragungskanals an.
- Der Kompetenz zum Erkennen von technischen Entwicklungen: Sie können den Nutzen und die Risiken der fortschreitenden Digitalisierung im Internet-of-Things beurteilen.

Content

Seminarinhalte:

- Strukturierung digitaler Kommunikation mit dem OSI-Referenzmodell
- OSI-Schicht 2:Fehlersicherung mittels CRCs (Cyclic Redundancy Codes) und ARQ (Automatic Retransmission Query)
- OSI-Schicht 3:Das Vermittlungsprotokoll IP (Internet Protocol)
- OSI-Schicht 4:Das Transportprotokoll TCP (Transmission Control)
- OSI-Schicht 7:Die Anwendungsprotokolle HTTP (Hypertext Transfer Protocol) & MQTT (Message Queue Telemetry Transfer)
- Grundlagen zellularer Mobilfunksysteme, veranschaulicht an den Beispielen 2. Generation GSM und 4. Generation LTE
- Überblick über Mobilfunksysteme 5. Generation
- Der offene LPWAN-Standard LoRaWAN (Long Range Wide Area Networks) für das IoT

Praktikumsversuche:

1. Fehlersicherung mit CRCs
2. Netzwerkanalyse und VoIP (Voice over IP)
3. MQTT (Message Queue Transfer Protocol):Ein Anwendungsprotokoll für das IoT (Internet of Things)
4. LoRaWAN:Ein Funkprotokoll für das IoT (Internet of Things)

Recommended literature

- S. Tanenbaum: Computer Networks, Prentice Hall, 5.Auflage, 2011
- A. Banks, R. Gupta: OASIS-Protocol Specification, OASIS-Open, MQTT Version 3.1.1, 2015
- M. Sauter: From GSM to LTE-Advanced Pro and 5G, John Wiley & Sons, 1.Auflage, 2017

Module name	Elektrische Antriebstechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT42	EAT	4,6, IBE 5	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Hagl	Prof. Dr. Hagl	SU,Ü,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	120 h	105 h	75 h

Applicability of the module in the degree programmes
EGT, EIT, MB, MEC, MT, KT
Mandatory requirements according to examination regulations
keine
Recommended prerequisites
Grundlagen der Physik und Elektrotechnik
Intended learning objectives
Die Studierenden erhalten Kompetenzen in der Wirkungsweise von elektromagnetischen Motoren und Auslegung elektrischer Antriebe als mechatronisches System. Dabei werden zusätzlich zum Motor die Regelungs- und Steuerungseinrichtungen, Leistungselektronik, Positionsmessgeräte und mechanische Übertragungselemente berücksichtigt. Die Studierenden verstehen die Auslegung von elektrischen Antriebssystemen, können passende Motoren für die jeweilige Antriebsaugabe auswählen und technische Daten von Antriebskomponenten verstehen.
Brief description of the module
Die Grundlagen für alle Komponenten eines Antriebsstranges mit einer elektrischen Maschine als Energiewandler werden behandelt. Schwerpunkt sind industriell eingesetzte elektromagnetische Maschinen. Es erfolgt eine Einführung in wichtige Verfahren der Steuerung und Regelung von elektrischen Antrieben.

Content

Vorlesung:

- Mechanische Übertragungselemente
- Grundlagen elektrischer Maschinen
- Grundlagen Drehstrommaschinen
- Gleichstrom-, Schritt-, AC Synchron- und Asynchronmotoren, Sanftanlaufgerät und Frequenzumrichter
- Positionsmessgeräte
- Servoantriebe

Praktikum:

- Gleichstrommotor
- Schrittmotor
- Drehstrom-Asynchronmotor (Netzbetrieb, Betrieb am Frequenzumrichter und Sanftanlauf)
- Leistungsmessung und Energieeffizienz
- Servoantrieb

Recommended literature

- R. Hagl: Elektrische Antriebstechnik, Carl Hanser, 3.Auflage, 2021
- R. Fischer: Elektrische Maschinen, Carl Hanser, 17.Auflage, 2017
- D. Schröder: Elektrische Antriebe – Grundlagen, Springer, 5.Auflage, 2013
- H.D. Stölting, E. Kallenbach: Handbuch elektrische Kleinantriebe, Carl Hanser, 7.Auflage, 2011

Module name	Kontinuierliche Regelungstechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT43	RTK	4, IBE 5	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. King	Prof. King	SU, Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemster	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

EIT, MB, MEC, MT,

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Mathematik, Grundlagen der Laplace-Transformation, Bodediagramm

Intended learning objectives

Die Studierenden:

- verstehen die Methoden der mathematischen Beschreibung von Regelkreiselementen. Sie berechnen die Stabilität von Regelkreisen und wenden die Stabilitätskriterien an.
- untersuchen die Eigenschaften von (PID-)Reglern für beliebige Regelkreise und sie können entscheiden, welcher Regler für welche Strecke geeignet ist.
- stellen Kriterien für zeit-/frequenzoptimales Verhalten von Regelkreisen auf und planen damit geeignete Regler.
- verstehen die Grundlagen des zeitdiskreten Regelkreises und rechnen kontinuierliche entworfene Regelalgorithmen in zeitdiskrete um.

Brief description of the module

Das Modul „Kontinuierliche Regelungstechnik“ behandelt die Grundlagen der Regelungstheorie für kontinuierliche Regelstrecken. Darin sind u.a. die Beschreibung von Regelkreiselementen, die wesentlichen dynamischen Eigenschaften von Regelkreisen und ihre Analyse sowie ausgewählte Reglerentwurfsverfahren enthalten. Zur Umsetzung der kontinuierlich ausgelegten Regelalgorithmen auf einem digital arbeitenden Steuergerät wird abschließend auf die Grundlagen diskreter Regelkreise und die Zeitdiskretisierung kontinuierlicher Regler eingegangen.

Content

- Einführung in die Begriffe der Regelungstechnik und die wichtigsten Abkürzungen.
- Mathematische Beschreibungen von Regelkreiselementen im Zeit- und insbesondere im Frequenzbereich.
- Untersuchung der Regelkreiselemente anhand der mathematischen Beschreibung analytisch und graphisch, z.B. die Stabilität, Bode-Diagramm.
- Berechnung und Analyse geschlossener Regelkreise hinsichtlich zentraler Anforderungen an ihr Dynamikverhalten.
- Einfache Verfahren zum Reglerentwurf z.B. Einstellregeln, PID-Reglerentwurf z.B. im Bodediagramm.
- Experimentelle Analyse von Regelkreisen und Anwendung von Einstellregeln für einfache Regelungsverfahren.
- Grundlagen des diskreten Regelkreises und Reglerdiskretisierung.
- Übungen mit MATLAB zur Vertiefung des Stoffes

Recommended literature

- J. Lunze: Regelungstechnik 1, Springer Verlag, 12. Auflage, 2020
- H. Lutz, W. Wendt: Taschenbuch der Regelungstechnik, Europa-Lehrmittel, 12. Auflage, 2021
- R.C. Dorf, R.H. Bishop: Modern Control Systems, Pearson, 14. Auflage, 2021
- G. Schulz, C. Graf: Regelungstechnik 1, De Gruyter Oldenbourg, 5. Auflage, 2015

Module name	Digitale Signalverarbeitung		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT44	DSV	4, IBE 5	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stichler	Prof. Dr. Stichler	SU,Ü,Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	75 h	45 h	30 h

Applicability of the module in the degree programmes

EIT, MEC, MT,

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Signale und Systeme

Intended learning objectives

Die Studierenden wenden moderne Methoden der Digitale Signalverarbeitung an und bewerten diese:

- Sie analysieren diskrete Signale und Systeme im Zeit-, Frequenz- und Z- Bereich.
- Sie entwerfen LVI Systeme mit modernen Methoden der Digitalen Signalverarbeitung
- Sie bewerten LVI Systeme, insbesondere hinsichtlich ihrer Effizienz bei der Hardware-Implementierung
- Sie implementieren LVI Systeme auf modernen Hardware Architekturen.

Brief description of the module

In diesem Modul werden moderne Methoden der Digitalen Signalverarbeitung vermittelt und praktisch angewendet. Ca. ½ des Moduls befasst sich mit den theoretischen Grundlagen der Digitalen Signalverarbeitung, ¼ mit der unmittelbaren Anwendung der Methoden in einer Matlab-Entwicklungsumgebung und ¼ mit der Implementierung auf einer modernen Hardware Architektur. In einer Projektarbeit, die den SU direkt begleitet, wird die erlernte Theorie unmittelbar eingeübt und vertieft

Content

- Signale, Systeme und ihre Spektren: FT, DTFT, DFT, Z-Transformation
- Lineare Verschiebungsinvariante Systeme (LVI Systeme): Ein-/Ausgangs- und Zustandsbeschreibung
- Entwurf und Realisierung zeitdiskreter LVI-Systeme inkl. Quantisierungseffekte
- Abtastratenratenänderung und Multiratensysteme: Polyphasendarstellung, Halfband-Filter, CIC-Filter
- Spezielle Aspekte zur DFT <-> FFT: Summen- und Matrixdarstellung; pipelined FFT & sliding DFT

Recommended literature

- A. Oppenheim, R. Schafer: Discrete-Time Signal Processing, Pearson, 3.Auflage, 2013
- K. Kammeyer, K. Kroschel: Digitale Signalverarbeitung, Springer Verlag, 9.Auflage, 2018
- F. Harris: Multirate Signal Processing for Communication System, Prentice Hall, 1.Auflage, 2004
- G. Plonka et al: Numerical Fourier Analysis, Birkhäuser, 1.Auflage, 2018
- U. Meyer-Baese: Digital Signal Processing with Field Programmable Gate Arrays, Springer Verlag, 4.Auflage, 2014

Module name	Schaltungstechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT45	Schalt	4, IBE 5	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stubenrauch	Prof. Dr. Stubenrauch	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	50 h	40 h

Applicability of the module in the degree programmes

EIT, MEC

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Grundlagen der Elektrotechnik, Signale und Systeme, Elektrische Bauelemente

Intended learning objectives

Die Studierenden:

- verstehen die Eigenschaften der wesentlichen Grundschaltungen und übertragen dies auf den sinnvollen Einsatz und Abfolge der Grundschaltungen
- berechnen Verstärkungen und Ein-/Ausgangsimpedanzen und interpretieren die darin enthaltenen Abhängigkeiten von Schaltungsparametern
- analysieren grundlegende lineare und nichtlineare Schaltungen
- entwerfen, dimensionieren und simulieren Schaltungen praxisgerecht im Frequenz- und Zeitbereich
- kennen die mathematische Darstellung von Rauschsignalen und berechnen die Auswirkungen von Rauschen in Schaltungen
- analysieren und entwerfen einfache digitale Schaltungen mit Transistoren.

Brief description of the module

Im Modul Schaltungstechnik werden Grundschaltungen, Tranistorschaltungen, Oszillatoren und Schaltungstechnik für Digitalschaltungen behandelt.

Content

Vorlesung:

- Bipolartransistor, FET: Grundgleichungen, Kennlinien
- Kleinsignal-Ersatzschaltbilder
- Transistor als linearer Verstärker (Transistor-Grundschaltungen, typische Folgen von Transistor-Grundschaltungen)
- Schaltungen mit mehreren Transistoren (Kaskodeschaltung, Differenzverstärker, Stromquellen, aktive Lasten)
- Ausgangsstufen
- Grundlagen zu Rauschen in Schaltungen
- Verstärker mit Gegenkopplung
- OPV als Beispiel für komplexere Analogschaltungen
- Oszillatoren
- Filter
- Schaltungstechnik für Digitalschaltungen

Recommended literature

- P.R. Grey, P.J.Hurst, S.H.Lewis, R.G. Meyer: Analysis and Design of Analog Integrated Circuits, John Wiley, 5.Auflage, 2009
- D.A. Neamen: Electronic Circuit Analysis and Design, McGraw-Hill, 2.Auflage, 2000
- U. Tietze, C. Schenk, E. Gramm: Halbleiter-Schaltungstechnik, Springer, 16.Auflage, 2019
- B. Razavi: Design of Analog CMOS Integrated Circuits, McGraw-Hill, 2.Auflage, 2016

Module name	Projektarbeit „Systemkomponenten“		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT4-P	ProjA-2	4, IBE 5	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Studiendekan	Professoren der Fakultät	PA	-
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	90 h	0 h

Applicability of the module in the degree programmes

EIT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Alle regulären Module der ersten 3 Semester, insbesondere der Projektarbeit „Elektronische Baugruppen“

Intended learning objectives

Die Teilnahme an diesem Projektmodul versetzt die Studierenden in die Lage

- elektronische Baugruppen zu komplexeren Komponenten eines Zielsystems zusammenzusetzen,
- und damit das bislang erworbene Fachwissen zu vertiefen und methodisch anzuwenden,
- Methoden des Projektmanagements („agil“ oder „klassisch)“ zu verstehen und zu bewerten,
- und im Nachgang die Qualität und mögliche Fehler beim Projektverlauf zu analysieren und zu benennen.

Brief description of the module

Dieses Modul bildet den zweiten Teil von drei aufeinander aufbauenden Projektarbeiten. In jedem der drei Teile soll – in sich abgeschlossen – gemeinsam mit den Studierenden ein eigenes Arbeitsziel definiert werden, das die Teilnehmer dann in kleinen Gruppen unter Anleitung eines Professors weitgehend selbständig bearbeiten. Bei der Bewertung des Moduls in Form einer Prüfungsstudienarbeit wird die Qualität der Arbeitsleistung des Studierenden an dem Projektziel gemessen. In diesem zweiten Teil werden Komponenten erstellt, die dann im dritten Teil zum Zielsystem integriert werden können.

Content

Ab dem 4. Semester werden ingenieurwissenschaftliche Fachinhalte gelehrt. Inhalte der zweiten Projektarbeit Systemkomponenten könnten beispielsweise sein:

- Ggf. Fertigstellung der Konzeptidee für ein Gerät oder ein komplexeres System
- Ggf. Fortsetzung Erstellung von Software, auf der Baugruppe und/oder zur Kommunikation mit dieser Baugruppe
- Durchführung einer Investitionsrechnung
- Entwicklung einer Regelung oder einer Steuerung auf Komponentenebene

Recommended literature

- Wird aktuell bekanntgegeben

Module name	Software Engineering		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT61	SE	6, IBE 7	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
N.N.	N.N.	SU, Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

EIT, MT

Recommended prerequisites

Informatik Grundlagen, Hardwarenahe Programmierung, Mikrocomputertechnik, Objektorientierte Programmierung, Grundlagen der objektorientierten Programmierung in C++

Intended learning objectives

Die Studierenden können:

- einen agilen Software Entwicklungsprozess anwenden
- im Team Software entwickeln
- eigenständig Requirements erfassen
- Software Architekturen modellieren und bewerten
- die gängigsten Design-Patterns anwenden und bewerten
- Software implementieren, dokumentieren und bewerten
- Software testen und Tests automatisieren
- Software bezüglich Qualitätskriterien, Safety und Security bewerten

Brief description of the module

Die Studierenden lernen im Rahmen des Moduls die zweckmäßigen Methoden, Verfahren und Werkzeuge zur Entwicklung von Software kennen. Der Fokus liegt hierbei auf der Entwicklung objektorientierter Software im Team nach agilen Methoden. Die Studierenden lernen ausgehend von einer Problemstellung im Team User Stories, Use Cases und Requirements zu formulieren, die Architektur Qualitätskriterien folgend zu modellieren, die Software umzusetzen, zu testen und auszuliefern.

Content

Vorlesung:

- Software Entwicklungsprozesse
- Requirements Engineering
- Software Modellierung und Dokumentation
- Software Architekturentwurf und Patterns
- Softwaretest: Testverfahren, Testebenen
- Safety, Reliability und Security
- Softwarequalität
- Versionsverwaltung

Praktikum:

- Durchführung eines Software Entwicklungsprojekts von der Formulierung der Requirements über Design, Modellierung, Implementierung, Integration und Testing hin zum Release
- Agile Softwareentwicklung im Team
- Kollaborative Versionsverwaltung und Continuous Integration

Recommended literature

- I. Sommerville: Software Engineering, Pearson, 10.Auflage, 2016
- R.C. Martin: Clean Architecture, Addison-Wesley, 1.Auflage, 2017
- R.C. Martin: Clean Code, Addison-Wesley, 1.Auflage, 2017
- E. Gamma et al.: Design Patterns:Entwurfsmuster als Elemente wiederverwendbarer objektorientierter Software, MITP Verlag, 1.Auflage, 2015
- S. Zörner, G. Starke: Softwarearchitekturen dokumentieren und kommunizieren:Entwürfe, Entscheidungen und Lösungen nachvollziehbar und wirkungsvoll festhalten, Carl Hanser Verlag, 1.Auflage, 2012
- G. Starke, P. Hruschka: arc42 in Aktion, Carl Hanser Verlag, 2.Auflage, 2022

Module name	Leistungselektronik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT62	LE	5,6,7, IBE 8	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Seliger	Prof. Dr. Seliger	SU,Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Winter-/Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	90 h	30 h	30 h

Applicability of the module in the degree programmes

EIT, MEC

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Gleich-& elementare Wechselstromlehre, Wechselstrom-& Feldlehre, Elektronische Bauelemente,Signale & Systeme, Elektrische Antriebstechnik, Schaltungstechnik

Intended learning objectives

Vorlesung:

- Eigenschaften des Schaltbetriebs, Leistungsbilanz
- Entwurf, Berechnung und Dimensionierung von Stromrichterschaltungen mit Dioden und Thyristoren, von Gleichstromsteller-Schaltungen und Umrichterschaltungen.
- Auswahl und Dimensionierung geeigneter Leistungshalbleiter (Ansteuerung, Kühlung).

Praktikum:

- Anwendung von LTSPICE in der Leistungselektronik
- Dimensionierung, Aufbau und Messung von Stromrichterschaltungen mit Dioden und Thyristoren
- Dimensionierung, Aufbau und Messung von Gleichstromstellern (Schaltnetzteile)
- Analyse des Schaltbetriebs eines Umrichters mit Gleichspannungszwischenkreis

Die Studenten haben Fähigkeiten in:

- Fachspezifischen Grundlagen
- Analyse und Strukturierung technischer Probleme
- Fähigkeiten, vorhandenes Wissen selbstständig zu erweitern
- Kenntnissen von praxisrelevanten Aufgabenstellungen

Brief description of the module

- Die Studenten sind in der Lage Stromrichterschaltungen mit Dioden und Thyristoren, Gleichstromsteller-Schaltungen und Umrichterschaltungen nach Spezifikation zu berechnen, die Bauelemente zu dimensionieren und einfache Schaltungen messtechnisch zu analysieren.
- Die Studenten können die Schaltungen mit modernen Schaltungssimulatoren modellhaft analysieren.

Content

Vorlesung:

1) Eigenschaften des Schaltbetriebs, Leistungsbilanz
2) Leistungshalbleiter (Aufbau, Eigenschaften, Kenngrößen)
3) Wide-Band Gap Transistoren
4) Stromrichterschaltungen mit Dioden und Thyristoren
5) Gleichstromsteller (Schaltnetzteile)
6) Umrichter mit Gleichspannungs-Zwischenkreis
7) Mehrlevel-Umrichter
8) Einführung in die elektromagnetische Verträglichkeit

Praktikum:

9) LTSPICE in der Leistungselektronik
10) Stromrichterschaltungen
11) Gleichstromstellerschaltungen
12) Umrichter mit Gleichspannungszwischenkreis
13) Leistungselektronik und EMV

Recommended literature

- U. Probst: Leistungselektronik für Bachelors, Carl Hanser Verlag, 4.Auflage, 2020
- J. Specovius: Grundkurs Leistungselektronik, Springer Vieweg, 10.Auflage, 2020
- R. Felderhoff: Leistungselektronik, Carl Hanser Verlag, 4.Auflage, 2006
- U. Schlienz: Schaltnetzteile und ihre Peripherie, Springer Vieweg, 7.Auflage, 2020
- N. Mohan: Power Electronics, John Wiley & Sons, 3.Auflage, 2002
- C. Paul: Introduction to EMC, John Wiley & Sons, 2.Auflag, 2006
- D. Schröder: Leistungselektronische Bauelemente, Springer Verlag, 2.Auflage, 2006
- D. Schröder: Leistungselektronische Schaltungen, Springer Vieweg, 4.Auflage, 2019
- A. Wintrich, U. Nicolai, W. Tursky, T. Reimann: Applikationshandbuch Leistungshalbleiter, Semikron, 2.Auflage, 2015
- F. Zach: Leistungselektronik, Springer Vieweg, 5.Auflage, 2016

Module name	Entwicklung elektronischer Steuergeräte		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT63	EES	6, IBE 7	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Perschl	Prof. Dr. Perschl	SU, Ü, Pr	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes
EIT, MEC, MT
Mandatory requirements according to examination regulations
Pr mE (Praktikum mit Erfolg abgelegt)
Recommended prerequisites
Digitaltechnik, Messtechnik, Schaltungstechnik, Informatik
Intended learning objectives
Die Studierenden wenden moderne Methoden der Steuergeräteentwicklung an und bewerten diese. Sie verstehen elektronische Details der Steuergeräte Hardware. Sie kennen Methoden der Programmierung von Steuergeräten. Sie beurteilen die Kommunikationsmöglichkeiten moderner Steuergeräte. Sie kennen Methoden zum Management von großen Softwareprojekten.
Brief description of the module
In diesem Modul werden moderne Methoden zur Entwicklung elektronischer Steuergeräte vermittelt und praktisch angewendet. Ca. 1/3 des Moduls befasst sich mit der Elektronik-Hardware von Steuergeräten, 1/3 mit der Softwareentwicklung. Der Rest des Moduls umfasst zusätzlich relevante Themen, wie Projektmanagement, Lastenheft, Entwicklungsumgebung, Versionsverwaltung, Betriebssysteme, … Im Praktikum werden die Methoden aus der Vorlesung direkt an einem selbst zu definierenden Beispielprojekt angewendet.

Content

- Projektmanagement, Lastenheft, Pflichtenheft
- Mikrocontroller-Hardware als „Herz“ von Steuergeräten
- Ansteuerung von Sensorik und Aktorik
- Verkabelung, Anschlusstechnik, Gehäuse
- Vernetzung und Kommunikation von Steuergeräten (Bussysteme)
- Entwicklungsumgebungen, Versionsverwaltung, …
- Softwareentwicklung für Steuergeräte
- Echtzeit-Betriebssysteme, Autosar
- Taskbasierte Softwareentwicklung

Recommended literature

- Skript: Entwicklung elektronischer Steuergeräte
- Infineon / Cypress: Automotive PSoC 4: PSoC 4200M Family Datasheet, Document Number 002-09829 Rev. *F, 13.12.2019
- Infineon / Cypess: PSoC Creator – User Guide, Document Number 001-93417 Rev. *M

Module name	Hochfrequenztechnik		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT64	HF-Tech	4, IBE 5	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Seliger	Prof. Dr. Seliger	SU,Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	90 h	30 h	30 h

Applicability of the module in the degree programmes

EIT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Grundlagen der Elektrotechnik, Signale und Systeme, el. Bauelemente, Schaltungstechnik, physikalische Grundlagen

Intended learning objectives

Die Lehrveranstaltung Hochfrequenztechnik soll die Studierenden in die Lage versetzen:

- auf verschiedenen Wellenleitern geführte Wellen sowie Schaltungen unter Einbeziehung von Wellenleitern berechnen zu können,
- Grundlagen für den Rechnergestützten Entwurf von HF-Schaltungen und Komponenten zu erhalten,
- die spezifischen Aspekte von HF Verstärkern und Mischern zu verstehen und anwenden zu können,
- die Grundlagen der Antennen Theorie und die Charakterisierung von Antennen zu verstehen und anwenden zu können,
- Aktive (lineare und nichtlineare) und passive HF-Schaltungen und Baugruppen unter Einbeziehung von Sende- und Empfangsantennen praxisgerecht entwerfen und dimensionieren zu können.

Brief description of the module

Einführung in die Theorie und Praxis der Anwendung von elektromagnetischen Wellenfeldern. Die Studierenden lernen Methodiken zur Beschreibung und Berechnung passiver und aktiver Bauelemente für den Einsatz in modernen elektronischen Baugruppen der Hochfrequenztechnik. Im Rahmen eines Praktikums wenden Studierende numerische Verfahren zur Beschreibung von Wellenfeldern an und entwickeln einfache aktive und passive Hf-Schaltungen. Diese werden messtechnisch analysiert und bezüglich ihrer Eigenschaften verifiziert.

Content

Vorlesung:

- Grundlagen elektromagnetischer Wellen (ebene el. magn. Welle, Bandleitung, TEM Leitung)
- TEM- Leitungen im eingeschwungenen Zustand* Impedanztransformation, Smithdiagramm
- Passive Schaltungen und Filter mit Leitungen
- Leitungsparameter, Dispersion, Phasen- und Gruppenlaufzeit
- Impulse auf Leitungen* Verkoppelte Leitungen
- S-Parameter, Verstärkung, Stabilität von Vierpolen
- Leistungsanpassung von Vierpolen* HF- Verstärker
- Frequenzumsetzung, Mischer* Gruppenstrahler
- Kenngrößen von Antennen

Praktikum:

- Wellenausbreitung in homogenen Leitungen; Impedanz und Reflexionsfaktormessung (Messleitung)
- Impedanztransformation durch Leitungen, Reflexionsfaktor, Leitungen als „diskrete Bauelemente“ (Simulation: LTSPICE, QUCS, CONMTL)
- Passive Mikrostreifenleiter Schaltungen (Filter, Ringkoppler, Simulation mit QUCS, CONMTL)
- Entwurf eines einstufigen HF- Verstärkers mit Mikrostrip Anpassschaltungen (mehrere Termine) (Simulation mit QUCS, CONMTL, Fertigung, Vermessung mit NWA)
- Nichtlineare HF- Schaltungen (Intermodulation, Mischer), Grundlagen zu Antennen (Simulationen mit EZNEC/PythonNEC, Simulation mit QUCS, CONCEPT-II)

Recommended literature

- H.G. Unger: Elektromagnetische Wellen auf Leitungen, Eltex Studientexte Elektrotechnik, Hüthig Verlag, 4.Auflage, 1996
- E. Voges: Hochfrequenztechnik Band 1: Bauelemente und Schaltungen Eltex Studientexte Elektrotechnik, Hüthig Verlag, 2.Auflage, 1991
- E. Voges: Hochfrequenztechnik Band 2: Leistungsröhren, Antennen, Funkübertragung, Funk- und Radartechnik, Eltex Studientexte Elektrotechnik, Hüthig Verlag, 2.Auflage, 1991
- D.M. Pozar: Microwave Engineering, John Wiley & Sons, 4.Auflage, 2012
- G. Zimmer: Hochfrequenztechnik, Lineare Modelle, Springer Verlag, 1.Auflage, 2000
- J. Detlefsen, U. Siart: Grundlagen der Hochfrequenztechnik, Oldenburg Verlag, 4.Auflage, 2012
- F. Gustrau: Hochfrequenztechnik, Carl Hanser Verlag, 3.Auflage, 2019
- O. Zinke, H. Brunswig: Hochfrequenztechnik 1: Hochfrequenzfilter, Leitungen, Antennen, Springer Verlag, 6.Auflage, 2000
- O. Zinke, H. Brunswig: Hochfrequenztechnik 2: Elektronik und Signalverarbeitung, Springer Verlag, 5.Auflage, 1999

Module name	Projektarbeit „Systemintegration“		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT6-P	ProjA-3	6, IBE 7	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Studiendekan	Professoren der Fakultät	PA	-
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Sommersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	90 h	0 h

Applicability of the module in the degree programmes

EIT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Alle regulären Module des bisherigen Studiums, insbesondere der Projektarbeit „Systemkomponenten“

Intended learning objectives

Die Teilnahme an diesem Projektmodul versetzt die Studierenden in die Lage

- elektronische Komponenten zu einem Zielsystem zusammenzusetzen,
- und damit das bislang erworbene Fachwissen zu vertiefen und methodisch anzuwenden,
- Methoden des Projektmanagements („agil“ oder „klassisch)“ zu verstehen und zu bewerten,
- und im Nachgang die Qualität und mögliche Fehler beim Projektverlauf zu analysieren und zu benennen.

Brief description of the module

Dieses Modul bildet den dritten Teil von drei aufeinander aufbauenden Projektarbeiten. In jedem der drei Teile soll – in sich abgeschlossen – gemeinsam mit den Studierenden ein eigenes Arbeitsziel definiert werden, das die Teilnehmer dann in kleinen Gruppen unter Anleitung eines Professors weitgehend selbständig bearbeiten. Bei der Bewertung des Moduls in Form einer Prüfungsstudienarbeit wird die Qualität der Arbeitsleistung des Studierenden an dem Projektziel gemessen. In diesem finalen Teil werden die bislang erstellten Komponenten in ein Zielsystem integriert.

Content

Im 4., 5. und 6. Semester werden ingenieurwissenschaftliche Fachinhalte gelehrt. Inhalte der dritten Projektarbeit Systemintegration könnten beispielsweise sein:

- Zusammenschaltung mehrerer Baugruppen oder Geräte
- Ergänzung der Software um Fähigkeiten der künstlichen Intelligenz
- Ergänzung der Software zur Kommunikation zwischen den einzelnen Komponenten des Systems und/oder mit dem Internet
- Fertigstellung eines elektronischen Steuergerätes für eine Maschine
- Entwicklung einer Software zur Regelung oder Steuerung eines Gesamtsystems
- Umsetzung einer Qualitätssicherungsmaßnahme, durch Modifikation der Hard- und/oder Software eines bereits bestehenden Gerätes oder Systems

Recommended literature

- Wird aktuell bekanntgegeben

Module name	Maschinelles Lernen		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT71	ML	7, IBE 8	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stichler	Prof. Dr. Stichler	SU,Ü	4
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	60 h	54 h	36 h

Applicability of the module in the degree programmes

EIT, MEC, MT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Programmiererfahrung in einer höheren Programmiersprache (z.B. C/C++, Python oder Matlab)

Intended learning objectives

Die Studierenden:

- Kennen die grundlegende Herangehensweise bei der Lösung von Problemen mittels maschinellem Lernen.
- Können ein Problem im Bereich maschinelles Lernen formulieren und einordnen.
- Können Daten vorverarbeiten und visualisieren.
- Kennen Algorithmen zur Klassifikation und Regression und deren Vor- und Nachteile.
- Können Regressions- und Klassifikationsprobleme lösen und die resultierende Performance anhand von Metriken und Lernkurven beurteilen.
- Verstehen das Konzept neuronaler Netze und können diese in der Praxis zur Klassifikation heranziehen und Ergebnisse beurteilen.

Brief description of the module

Das Modul Maschinelles Lernen bietet den Studierenden eine Einführung in die Thematik beginnend mit einfachen linearen und logistischen Modellen zur Regression und Klassifikation. Sind Grundlagen bezüglich Beurteilung von Modellen, Over- und Underfitting, Regularisierung sowie die Datenvorverarbeitung einschließlich Aufteilung verstanden, lernen die Studierenden komplexere Modelle und deren Vor- und Nachteile kennen.

Content

- Problembeschreibung und Datenvorverarbeitung
- Lineare Regression
- Logistische Regression
- Regularisierung
- Support Vector Machines
- Dimensionalitätsreduktion
- Neuronale Netze
- Convolutional Neural Networks

Recommended literature

- A. Géron: Hands-On Machine Learning with Scikit-Learn & Tensorflow, O'Reilly, 1.Auflage, 2017
- C. Bishop.: Pattern Recognition and Machine Learning, Springer, 2.Auflage, 2011
- G. James et al.: An Introduction to Statistical Learning, Springer, 2.Auflage, 2021

Module name	Nachrichtenübertragung		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT72	NT	7, IBE 8	5
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Prof. Dr. Stichler	Prof. Dr. Stichler	SU, Ü, Pr	5
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
150 h	75 h	45 h	30 h

Applicability of the module in the degree programmes

EIT, MEC

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Signale und Systeme; Digitale Signalverarbeitung

Intended learning objectives

Die Studierenden wenden moderne Methoden der Nachrichtenübertragung an und bewerten diese:

- Sie analysieren, charakterisieren und bewerten einen Übertragungskanal im Zeit-, und Frequenz-Bereich.
- Sie verstehen und bewerten analoge und digitale Übertragungsverfahren im Zeit-, Frequenz-Bereich.
- Sie entwerfen analoge und digitale Empfänger mit modernen Methoden der Digitalen Signalverarbeitung.
- Sie implementieren analoge und digitale Sender und Empfänger als Software Defined Radios.

Brief description of the module

In diesem Modul werden moderne Methoden der Nachrichtenübertragung vermittelt und praktisch angewendet. Ca. ½ des Moduls befasst sich mit den theoretischen Grundlagen der Nachrichtenübertragung, ¼ mit der unmittelbaren Anwendung der Methoden in einer Matlab-Entwicklungsumgebung und ¼ mit der Implementierung als Software Defined Radios. In einer Projektarbeit, die den SU direkt begleiten, wird die erlernte Theorie unmittelbar eingeübt und vertieft.

Content

- Übertragungskanal
- Analoge (AM/FM/PM) und digitale Übertragungsverfahren (ASK/PSK/QAM; FSK/CPM/MSK)
- Grundlagen digitaler Übertragungsverfahren:
- Augendiagramme und Nyquist Bedingungen
- Matched Filter; und Fehlerraten
- Multiplex-Verfahren: TDMA, FDMA, CDMA und OFDM
- Empfängerstrukturen:
- Kanalschätzung und Entzerrung
- Synchronisation: Carrier- und Timing Recovery

Recommended literature

- K. Kammeyer, A. Dekorsy: Nachrichtenübertragung, Springer Verlag, 6.Auflage, 2018
- B. Farhang-Boroujeny: Signal Processing Techniques for Software Radios, Behrouz Farhang-Boroujeny, 2.Auflage, 2010

Module name	Fachbezogene Wahlpflichtmodule		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT-WP	EIT-WP: FWPM	5, 6 und/oder 7, IBE 6,7 und/oder 8	13
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Studiendekan	-	SU / Ü / Pr	-
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe FWPM-Katalog der Fakultät	1 Semester	Sommer- und Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
390 h	siehe Eintrag im FWPM-Katalog der Fakultät, 390 h	0 h	0 h
Applicability of the module in the degree programmes			
EIT			
Mandatory requirements according to examination regulations			
siehe FWPM-Katalog der Fakultät			
Recommended prerequisites			
siehe FWPM-Katalog der Fakultät			
Intended learning objectives			
siehe FWPM-Katalog der Fakultät			
Content			
siehe FWPM-Katalog der Fakultät			

Module name	Praxisbegleitende Lehrveranstaltungen 1		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT-PL1	PLV1: Dokumentation und Präsentation	5, IBE 6	2
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Praktikantenbeauftragter des Studiengangs	Dokumentation: Prof. Dr. Schroeter; Präsentation: Fr. Fleck-Gottschlich, Fr. Zimmermann-Beck, Fr. Weber	SU/Ü	2
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
60 h	24 h	22 h	14 h
Applicability of the module in the degree programmes			
EIT, IBE, MB, MEC, MT, KT			
Mandatory requirements according to examination regulations			
keine			
Recommended prerequisites			

Intended learning objectives

Dokumentation:

- Die Studierenden erstellen wissenschaftliche Dokumentationen.

Präsentation:

- Die Studierenden kennen die 7 Elemente einer erfolgreichen Präsentation und wenden diese in Präsentationen an.
- Die Studierenden entwickeln zu fachlichen Themen Präsentationen und bereiten diese so vor, dass eine klare Struktur und ein roter Faden zugrunde liegen.
- Die Studierenden gestalten ihre Präsentation so, dass auch Nicht-Fachkundige diese verstehen.
- Die Studierenden präsentieren mit optimiertem Einsatz von Sprache, Stimme sowie Körpersprache.
- Die Studierenden präsentieren mit erweiterter Medienkompetenz. Neben Laptop und Beamer binden Sie auch „klassischen“ Medien z.B. Flipchart, Pinnwand, Modelle und Bildmaterial in die Präsentationen ein.
- Die Studierenden illustrieren ihre Präsentation durch unterschiedliche Präsentationstechniken.
- Die Studierenden entwickeln ihre eigene Sprech- und Auftrittsfähigkeit (technisch und persönlich) weiter, mit dem Ziel, souverän zu präsentieren.

Brief description of the module

Die Lehrveranstaltung dient dem Erlernen der Grundlagen technisch-wissenschaftlicher Dokumentationen sowie dem Erlernen eines tieferen Verständnisses für die vielfältigen Einsatzmöglichkeiten der Präsentationstechniken. Die Studierenden präsentieren mit erweiterter Medienkompetenz. Die Studierenden entwickeln ihre eigene Sprech- und Auftrittsfähigkeit weiter mit dem Ziel, souverän zu präsentieren.

Content

Dokumentation:

- Definition von Dokumentation
- Begründung der Notwendigkeit der Dokumentation
- Wichtige Beispiele von Dokumentationen
- Übung einer Dokumentation (Versuchsprotokoll)
- Vorstellung des Leitfadens der Fakultät für die Dokumentation einer wissenschaftlichen Arbeit

Präsentation:

- Einstieg in die Präsentationstechniken
- Vorbereitung / Aufbau und Struktur / Rhetorik / Körpersprache / Stimme / Medieneinsatz / Visualisierung mit mindestens zwei Medien/ Umgang mit Zuhörern /
- Erstellung eines Handouts: Sinn und Zweck
- Erstellung einer Präsentation u.a. Einsatz der Masterfolie
- Interaktion (Kurzvorträge/Präsentationen anhand praktischer Themenstellungen) mit Videoanalysen
- Halten einer Abschlusspräsentation inkl. Handout und mit Videoanalyse

Recommended literature

- D. Juhl, W. Küstenmacher: Technische Dokumentation. Praktische Anleitungen und Beispiele, Springer Vieweg, 3.Auflage, 2015
- N.N.: Leitfaden für das Erstellen von Abschlussarbeiten in der Fakultät für Ingenieurwissenschaften, Technische Hochschule Rosenheim, Fakultät für Ingenieurwissenschaften, 2020
- N.N.: Gebrauchsanleitungen – IHK-Leitfaden zur Erstellung. Benutzerinformation in Anlehnung an die EN 82079-1., Industrie- und Handelskammer, 2015
- N. Durate: slide: ology-Oder die Kunst, brillante Präsentationen zu entwickeln, O'Reilly Media, 1. Auflage, 2009
- P. Flume: Präsentieren mit iPad & Co, Haufe-Lexware, 1. Auflage, 2013
- G. Reynolds: Zen oder die Kunst der Präsentation:Mit einfachen Ideen gestalten und präsentieren, dpunkt.verlag GmbH, 2.Auflage, 2013
- S. Peipe: Visualisieren in Workshops, Meetings und Präsentationen: Einfach, klar und kreativ, Haufe Lexware, 1. Auflage, 2019
- A. Gerhardt: Business-Symbole zeichnen für Dummies, Wiley-VCH, 1. Auflage, 2020

Module name	Praxisbegleitende Lehrveranstaltungen 2		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT-PL2	PLV2: VHB Kurs Einführung in die Betriebswirtschaft für Ingenieure	5, IBE 6	2
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Praktikantenbeauftragter des Studiengangs	-	Virtuelle Vorlesung	2
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
60 h	30 h	18 h	12 h

Applicability of the module in the degree programmes
EIT, IBE, MB, MEC, MT, KT
Mandatory requirements according to examination regulations
keine
Recommended prerequisites
Intended learning objectives
s. VHB Kurs Einführung in die Betriebswirtschaft für Ingenieure
Brief description of the module
s. VHB Kurs Einführung in die Betriebswirtschaft für Ingenieure
Content
s. VHB Kurs Einführung in die Betriebswirtschaft für Ingenieure

Recommended literature
• s. VHB Kurs Einführung in die Betriebswirtschaft für Ingenieure

Module name	Praxisbegleitende Lehrveranstaltungen 3		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT-PL3	PLV3: Grundlagen des Projektmanagements	5, IBE 6	2
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Praktikantenbeauftragter des Studiengangs	Prof.Dr.Reuter	SU, Ü	2
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
60 h	30 h	18 h	12 h

Applicability of the module in the degree programmes

EIT, IBE, MB, MEC, MT, KT

Mandatory requirements according to examination regulations

keine

Recommended prerequisites

Intended learning objectives

Die Studierenden

- kennen die grundlegenden Begriffe und Instrumente des Projektmanagements (PM).
- kennen den Aufbau, die Formen und die Funktionsweise von Projektorganisationen.
- kennen Projektinitiierungsquellen und können Kreativitätstechniken anwenden.
- wenden die wichtigsten Projektplanungs- und Steuerungsinstrumente an.
- sind vertraut mit den Grundsätzen der Teambildung, der Gruppendynamik und des Konfliktmanagements.
- sind in der Lage die Grundlagen, Methoden und Verfahren des PM anzuwenden und sind auf dieser Basis in der Lage, selbstständig im Team Projekte zu planen und zu bearbeiten.

Brief description of the module

Die Lehrveranstaltung dient dem Erlernen der Grundlagen des Projektmanagements, mit dem Fokus auf die Anwendung in Projekten.

Content

- Merkmale des Projektmanagement
- Projektplanung
- Projektlebenszyklus
- Phasen und Meilensteine
- Projektstrukturierung
- Ablauf- und Terminplanung
- Ressourcenplanung / Kostenplanung
- Projektorganisation
- Risikomanagement
- Projektsteuerung
- Kommunikation / Teamarbeit
- Projektdokumentation

Recommended literature

- H.Timminger: Modernes Projektmanagement, Wiley-VCH, 1.Auflage, 2017
- H.-D.Litke: Projektmanagement, Carl Hanser, 5.Auflage, 2007
- M.Burghardt: Projektmanagement, Publicis Publishing, 10.Auflage, 2018
- M.Burghardt: Einführung in Projektmanagement, Publicis Publishing, 6.Auflage, 2013
- W. Jakoby: Projektmanagement für Ingenieure, Springer Vieweg, 5.Auflage, 2021
- Skriptum zur Lehrveranstaltung

Module name	Studienbegleitendes Praktikum		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
EIT-SP	SP	5. / IBE 6. Studiensemester oder Praxisphasen P3 bis P6	24
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Praktikantenbeauftragter des Studiengangs	-	Industriepraktikum	-
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	-	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
720 h	Industriepraktikum 720 h	0 h	0 h

Applicability of the module in the degree programmes

EIT, IBE, MB, MEC, MT, KT

Mandatory requirements according to examination regulations

Nachweis der Vorpraxis

Recommended prerequisites

Intended learning objectives

- Die Studierenden kennen organisatorische Abläufe in industriellen Betrieben.
- Die Studierenden wenden theoretisches Wissen auf praktische Aufgabenstellungen an.
- Die Studierenden erarbeiten Entscheidungsgrundlagen unter Berücksichtigung technischer und wirtschaftlicher Gesichtspunkte.
- Die Studierenden fügen sich in Teams ein und wenden Prinzipien einer erfolgreichen Teamarbeit an.
- Die Studierenden dokumentieren Arbeitsabläufe in technischen Berichten.

Brief description of the module

Im studienbegleitenden Praktikum führen die Studierenden ingenieursnahe Tätigkeiten anhand konkreter Aufgabenstellungen im industriellen Umfeld aus

Content

- Ingenieurmäßige Tätigkeiten in Industriebetrieben zu den Themen (Auswahl): Produktentwicklung, Konstruktion, Projektierung, Fertigung, Vertrieb, Montage, Inbetriebnahme, Betriebliche Energieversorgung, Service, Arbeitsvorbereitung, Betriebsorganisation, Informationsverarbeitung, Beschaffung, Logistik, (weitere vergleichbare Bereiche möglich)
- Dokumentation der Tätigkeiten

Recommended literature

- Fachliteratur je nach Aufgabenstellung

Module name	Bachelorarbeit		
Number(s)	**Abbreviation**	**Curriculum semester**	**ECTS**
BA	BA	7, IBE 8	12
Responsible for the module	**Lecturer(s)**	**Teaching form**	**SWS**
Studiendekan	die von der Prüfungskommission bestellten Prüfer	Bachelorarbeit	-
Form of examination	**Module duration**	**Module rotation**	**Language**
siehe SPO	1 Semester	Wintersemester	deutsch
Total workload	**= Presence**	**+ Self-study**	**+ Exam preparation**
360 h	Projektarbeit 300 h	Schriftliche Ausarbeitung 60 h	0 h

Applicability of the module in the degree programmes

EIT, IBE, MB, MEC, MT, KT

Mandatory requirements according to examination regulations

Bestehen des studienbegleitenden Praktikums

Recommended prerequisites

Intended learning objectives

- Die Studierenden gliedern, analysieren und lösen selbständig ein komplexes Problem aus dem Bereich der Ingenieurwissenschaften.
- Die Studierenden fügen sich in Teams ein und arbeiten selbständig und eigenverantwortlich mit.
- Die Studierenden wenden Methoden des Projektmanagements an.
- Die Studierenden dokumentieren und präsentieren die Bearbeitung und die Ergebnisse eines ingenieurwissenschaftlichen Projekts.

Brief description of the module

Mit der Bachelorarbeit weisen die Studierenden die Fähigkeit nach, innerhalb der vorgegebenen Frist die gegebene Problemstellung selbständig nach wissenschaftlichen Methoden zu bearbeiten.

Content

Ausgehend von einer klaren Zielsetzung lernen die Studierenden

- den diesbezüglichen Stand des Wissens und der Technik zu ermitteln.
- eigene Lösungsansätze zu entwickeln und zu überprüfen.
- ihre Arbeiten zu strukturieren.
- ihre Arbeiten in der Form einer wissenschaftlichen Arbeit schriftlich darzustellen.
- über ihre Zielsetzungen und Problemstellungen mit den.betreuenden Hochschullehrern und ggf. Betreuern in externen Unternehmen in sachlichen Austausch zu kommen.

Recommended literature

- N.N.: Leitfaden für das Erstellen von Abschlussarbeiten in der Fakultät für Ingenieurwissenschaften, Technische Hochschule Rosenheim, Fakultät für Ingenieurwissenschaften, 2020
- W. Jakoby: Projektmanagement für Ingenieure, Springer Vieweg, 5.Auflage, 2021