Industrial Engineering and Management

- Courses in English -

- Electrical engineering 1
- Electrical engineering 2
- Embedded systems 1 (introduction)
- Embedded systems 2 (software engineering)
- Embedded systems 3 (specialisation)
- Material science 2
- Material science 3
- Mathematics 3
- Project Management for engineers

This programme is only offered in the summer semester (April - July).
(Faculty of Life Sciences; January 2024)

Course Name: Electrical Engineering 1

Degree programme: **Industrial Engineering (**Bachelor)		Responsible Lecturer: Prof. Dr. Cornelia Stübig
Work load: 150 h	**Lecture hours per week: 4 hours /weekly**	**ECTS Credits: 5**

Course objectives:
Learning outcome: Students calculate electric circuits and give validated information about their behaviour.

Specialist comptency (knowledge and underständing):

- General understanding oft he fundamental principles of electrical engineering

Methodological competency (use, aplication and generation of knowledge):

- Methods needed in order to calculate the behaviour of single parts or the whole of an electric circuit are taught.

Social Competency (communication and cooperation):

- Group work is used with example problems in order to give students the opportunity to solve technical problems in a group.

Self-competency (scientific self-image, professionalism):
Students reflect their results and learn to estimate their own knowledge and results.

Contents:
1. Introduction, basic terms and definitions
2. Consumers and generators of electrical energy
3. DC circuit calculation
4. Electrostatic field, electrical current field, magnetic field
5. General electric circuits
6. Periodic functions
7. AC circuits
8. Three-phase current

About didactics and work load distribution:
Lecture including calculation examples, voluntarily: tutorial
60 h of lecture, 90 h of self-study

Requirements for participation:
Recommended: mathematics: complex numbers, vector calculation, linear equation systems
Mandatory: -

Type of exam:
Written exam, duration 90 minutes

Course language:
German
English on demand

Requirements for credit point allocation:
Regular attendance, assignments, exam

Literature:

- Hagmann, Gert: Grundlagen der Elektrotechnik, AULA-Verlag, 17. Auflage

Course Name: Electrical Engineering 2

Degree programme: **Industrial Engineering** (Bachelor) advanced students	Responsible Lecturer: Prof. Dr. Cornelia Stübig

Work load: 150 h	**Lecture hours per week: 5** Lectures (4 SWS), Tutorial (1 SWS)	**ECTS Credits: 5**

Course objectives:
Gives an overview about applications of electrical energy and serves as ground for all other subjects concerning electrical engineering.
Highly recommanded, if the M.SC. is planned in the area of electrical engineering.

Students acquire basic knowledge in areas of application of electrical systems. These include power engineering applications such as the generation, transport and use of electrical energy as well as basics on electronic components and their use in applications.

Methodological competency (use, aplication and generation of knowledge):

- Methods needed in order to calculate the behaviour of electric circuit are used in reference to technical applications and the behaviour is analyzed.

Self-competency (scientific self-image, professionalism):

- Students reflect their results and learn to estimate their own knowledge and results.

Contents:
General:
1. Standardisation and Safety

Power engineering:
2. Magnetic circuit
3. Transformer
4. Energy transmission
5. Generation of electrical energy
6. Electrical motors

(Power-)Elektronics:
7. Basics of semiconductortechnology
8. Semicondutor components
9. Electric circuits using semiconductors

About didactics and work load distribution:
By working in teams of two, using different learning methods (e. g. oral discussion of the respective experiment, introduction of another group into an experiment and presentation of own measurement results to the whole group), social competence, verbal expression and presentation skills are promoted.
Lecture including calculation examples, voluntarily: tutorial
Work load: 60 h of lectures, 90 h of self-study

Requirements for participation:

Recommended: Basics in Electrical engineering
Mandatory: -
preferably for 3rd year students

Course language:

English or German

Type of exam:
Written exam, duration 90 Minutes

Requirements for credit point allocation:

regular attendance, passed exams

Literature:

Fachkunde Elektrotechnik, Europa Lehrmittel, 31. Auflage 2018
Hagmann, Gert: *Grundlagen der Elektrotechnik*, AULA-Verlag, 17. Auflage

Course Name: Embedded Systems 1 – Basics

Degree programme: **Industrial Engineering 1st Semester** (Bachelor)	Responsible Lecturer: Prof. Dr. Volker Skwarek

Work load: 60 hrs	**Lecture hours per week: 2 SWS**	**ECTS Credits: 2**

Course objectives:

Student acquire basic knowledge about embedded systems, the general working principle of digital systems and circuits up to processor cores.

Gaining knowledge about digital problem analysis and –modelling basing on methods of binary logic.

Contents:

- Introduction into embedded systems
- number systems, algebra of binary numbers, data types and ranges
- semiconductors, -technologies
- coding theory
- digital and binary logic
- boolean algebra
- adder/subtractor, arithmetic logic unit, simple processor cores

About didactics and work load distribution:

Lecture

60 h, thereof 30 h presence study, 30h home study

Requirements for participation: Basic computer handling, A-level-knowledge of Physics, Chemistry, Electronics	**Course language:** English or German
Type of exam: Written exam: 40 minutes	

Requirements for credit point allocation: written exam

Literature:

D. Hoffmann: Grundlagen der Technischen Informatik, Hanser Verlag
Patterson/Hennessy: Computer Organisation and Design, The Morgan Kaufmann Series in Computer Architecture and Design

Course Name: Embedded Systems 2 – Software Engineering

Degree programme:
Industrial Engineering, 4th semester
(Bachelor)

Responsible Lecturer:
Prof. Dr. Volker Skwarek

Work load: 60 h	**Lecture hours per week: 2**	**ECTS Credits: 2**

Course objectives:
Students acquire qualifications and knowledge of the design process of software (software engineering). A special focus is put on requirements engineering and testing aiming to a qualification in systems engineering.

ontents:
- Software development process
  process models, design principles
- Requirements management
- Priciples for modeling software and embedded systems
  programming languages, direct and model based coding, coding patterns, documentation
- Debugging and test management
- Team based development
  software project management
  modularization
  design guidelines
- Functional safety

About didactics and work load distribution:
lectures in small groups with practical based homework
60 h, thereof 30 h presence study, 15 h voluntary homework and 15 h home study

Requirements for participation:
embedded systems 1, knowlegde of a higher programming language such as C, C++ or Java

Course language:
German or
English

Type of exam:
Written or oral exam: written - 75 minutes, oral 30-45 minutes

Requirements for credit point allocation: oral and written exam

Literature:
I. Sommerville: Software Engineering, Pearson
Hammerschall/Beneken: Requirements Engineering, Pearson

Course Name: Embedded Systems 3 – specialization in embedded systems

Degree programme: Industrial Engineering, 5th semester (Bachelor)	Responsible Lecturer: Prof. Dr. Volker Skwarek

Work load: 90 hrs	**Lecture hours per week: 3**	**ECTS Credits: 3** 2 ECTS lecture 1 ECTS lab

Course objectives:

Students acquire knowledge about special aspects of software development on and for microcontrollers. After this lecture and lab they shall be able to understand and to drive software development on microcontrollers and to solve simple programming tasks on controllers.

With lab exams first experience in developing software on µcontrollers will be gained.

Contents:

- **Special Aspects of embedded systems design**
  Time dependent modelling**,** shared memory modelling, event based modelling, VHDL
- **Sensors and actuators**
  Active and passive elements, AD/DA conversion
- **Process types**
- **Memory types**
- **Real time systems and scheduling**
  Real time operating systems, virtual machines, access protocols, real-time calculations and modelling
- **Design methods for low power systems**
- **Optimization of**
  Memory usage, code usage, run-time
- **Tool chains for code developement**

About didactics and work load distribution:

Lectures (2 SWS) in small groups with lab (1 SWS)
90 h, thereof 30 h presence study, 30h lab and preparation,15 h voluntary homework and 15 h home study

Requirements for participation: Embedded systems 1, knowledge of a higher programming language such as C, C++ or Java. Basics of Electrical Engineering, basics of electronics, maths	**Course language:** English or German
Type of exam: Written exam: 90 minutes, Lab evaluation with initial short exam. No fail allowed.	

Requirements for credit point allocation: written exam and practical lab exam

Literature:

Patterson/Hennessy: Computer Organisation and Design, The Morgan Kaufmann Series in Computer Architecture and Design
Bear: Microprocessor Architecture, Cambridge Press

Course Name: Material Sciences 2

Degree programme:
Industrial Engineering (Bachelor)

Responsible Lecturer: Prof. Dr. Marcus Schiefer
Prof. Dr. Bettina Knappe, Prof. Dr. Gesine Witt, external lecturers

Work load: 90 h	**Lecture hours per week: 2**	**ECTS Credits: 3**

Course objectives:
The participants learn safe working methods in laboratory and workshop with equipment, chemicals and tools. In addition, material science knowledge is deepened.
Students acquire / improve the ability

- to develop the subject contents independently and to present and discuss them orally in front of the group.
- for professional communication in group work through joint evaluation and reflection of the experiments.
- to precisely explain scientific and engineering facts, test observations and evaluations in technical language.
- to make observations about weight, load and quantity ratios by means of stoichiometric calculations.
- to apply basic chemical skills and simple analytical methods.
- to adequately implement the safety provisions in the conduct of experiments.

Contents: Chemistry lab: Quantitative and qualitative analysis, corrosion tests; Material science laboratory: determination of mechanical parameters, different non-destructive testing methods of components.

About didactics and work load distribution:
The students develop/improve the ability and willingness to work together within their team in a mutually supportive and goal-oriented manner to acquire the subject content.
The students
. . . treat the group members with esteem and self-confidence.
. . . carry out experiments without endangering persons.
. . . gain self-confidence and confidence in their own abilities.
30 h presence studies, 60 h self-studies

Requirements for participation:
no preconditions, recommended basic knowledge of material sciences

Type of exam:
report of laboratory work, test

Course language:
English

Requirements for credit point allocation:
regular attendance, passed test and regular laboratory report

Literature: Callister, William D., Rethwisch, David G.: Material Sciences and Engineering: SI Version, pocket book. Kammer, Cathrin, Läpple, Volker: Werkstofftechnik Maschinenbau: Theoretische Grundlagen und praktische Anwendungen, pocket book.

Course Name: Material Sciences 3

Degree programme:
Industrial Engineering (Bachelor)

Responsible Lecturer: Prof. Dr. Marcus Schiefer
Prof. Dr. Bettina Knappe, Prof. Dr. Gesine Witt, external lecturers

Work load: 60 h	**Lecture hours per week:** 2	**ECTS Credits: 2**

Course objectives:
The students acquire the competence to transfer theoretical contents and methods purposefully into the laboratory practice as well as to develop the acquired competences in laboratory experiments. They deepen their knowledge of material science contents.
Students improve their ability to reproduce material science facts, observations and evaluations in a scientifically correct manner in the respective technical language. You will acquire the competence to recognize problems in test execution and evaluation, to discuss sources of error and to develop solution strategies.
After completing this module, students will also have basic knowledge of laboratory work, such as the use of measurement methods and data acquisition systems, as well as writing protocols and reports.
The module is an additional basis for engineering science modules and thoroughly prepares students for a variety of practical laboratory work outside the university. It provides an essential basis for the correct documentation of scientific papers, which are also required during the Bachelor's thesis.

Contents:
The work focuses on electroplating experiments, experiments with non-ferrous metals and application-related material science issues. What has been learnt has strong application relevance and is illustrated by excursions.

About didactics and work load distribution:
By working in teams of two, using different learning methods (e. g. oral discussion of the respective experiment, introduction of another group into an experiment and presentation of own measurement results to the whole group), social competence, verbal expression and presentation skills are promoted.
30 h presence studies, 30 h self-studies

Requirements for participation:
Prerequisites in material sciences required. Passed material science 2 course or equivalent.

Course language:
English

Type of exam:
Written exam: 60 Minutes
Graded lecture in front of the group: 15 Minutes

Requirements for credit point allocation: regular attendance, passed exams and assignments

Literature: Callister, William D., Rethwisch, David G.: Material Sciences and Engineering: SI Version, pocket book. Kammer, Cathrin, Läpple, Volker: Werkstofftechnik Maschinenbau: Theoretische Grundlagen und praktische Anwendungen, pocket book.

Course Name: Mathematics 3

Degree programme: **Environmental Engineering** (Bachelor)	Responsible Lecturer: Prof. Dr. Rainer Sawatzki	
Work load: 75	**Lecture hours per week:** 2	**ECTS Credits: 2.5**

Course objectives:

Students will acquire the ability:

- to describe technical and scientific problems with the mathematical syntax.
- to use the basic concepts of differential and integral calculus, ordinary differential equations and series.
- to apply the tools of the aforementioned areas reliably.

Contents:

- general series, power series, Taylor and Fourier series
- Ordinary differential equations of first and second order

About didactics and work load distribution:

- Seminars with exercises (25%)
- working in small groups (25%)
- independent study (50%)

Requirements for participation:
Knowledge of calculus

Type of exam:
Written test

Course language:
English

Requirements for credit point allocation:
Active participation in class and successful completion of the final examination

Literature:

- Papula, Lothar: Mathematik für Ingenieure und Naturwissenschaftler 1-3
- Fetzer, Albert; Fränkel, Heiner: Mathematik Bd.1-2
- Engeln-Müllges, Gisela; Schäfer, Wolfgang; Trippler, Gisela: Kompaktkurs Ingenieurmathematik
- Dürrschnabel, Klaus: Mathematik für Ingenieure

Course Name: Project Management (for engineers)

Degree programme: Life Sciences International Semester – Industrial Engineering, BEETLS (Bachelor)	Responsible Lecturer: Prof. Dr. Andrea Berger-Klein/ Lothar Fuhr

Work load: 150 (64 h/ 4 SWS presence; 86 h self-study)	**Lecture hours per week: 4**	**ECTS Credits: 5 CP**

Course objectives:

Engineers have to take the lead and the resulting responsibility in her working area. More and more their daily work is done by project work. To be successful they need a very deep and holistic knowledge in international project management due to the situation that they have to plan and to implement projects.

Skills / Learning targets

Fundamentals

The students know…

- the basics of project management theory and tools,
- transfer the basic knowledge and most essential tools of project management into her special working area and
- structure projects in this content,
- practice the different project methods in her special working area.

Social and self-competence

The students are able …

- to work based on facts, highly self-motivated and open minded in a project team,
- to find successful solutions for basic project management problems,
- to work cooperatively in different degrees,
- to present her own input in an understandable way.

Contents:

- Project Management Tool Box like: WBS, CPM, Risk Management, Stakeholder Management, Earned Value Management, IT Tools like MS Project
- project process management
- case Studies
- useful solutions to set up teams and to lead project teams (lateral leadership)
- project related presentation, communication and facilitator skills

About didactics and work load distribution:

Blocked seminar with e-learning and multi-media…; problem based learning on case studies…

- presentation
- e-learning
- case studies
- homework during online session
- homework presentation
- excursion / project management in practice
- used medias: different medias on online platform, whiteboard, flipchart / board, beamer presentation

Requirements for participation: No requirements	**Course language:** English
Type of exam: presentation	
Requirements for credit point allocation: Participation at four of five blocked presence meetings, presentation about a given topic related to a study case	
Literature: • Project Management Institute (Hrsg.): A Guide to the Project Management Body of Knowledge, fifth edition, Pennsylvania 2014	