



# **Module Guide**

## **Industrial Engineering**

Faculty European Campus Rottal-Inn

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## IE-01 ANALYTICAL PRINCIPLES OF ENGINEERING

Module code	IE-01
Module coordination	Ibrahim Bader
Course number and name	Analytical Principles of Engineering
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

#### Module Objective

This module provides students with fundamental knowledge of mathematical principles and methods that are essential for engineering applications. Students will develop a solid understanding of mathematical concepts, enhance their problem-solving skills, and apply analytical techniques to engineering-related problems.

#### Professional Competence

##### Expertise

Upon successful completion of the module, students will get to:

- o Recognize and retrieve fundamental mathematical concepts, including set theory, real number fields, and logarithms.
- o Identify and apply standard mathematical procedures for solving engineering-related problems.
- o Interpret and analyze mathematical symbols, formulas, and objects, demonstrating an understanding of their significance in engineering contexts.

- o Apply numerical and graphical solution methods to mathematical and engineering problems.
- o Evaluate and manipulate complex numbers, matrices, and vector operations in engineering applications.
- o Solve systems of linear equations using various mathematical techniques.
- o Determine the convergence or divergence of sequences and series of real numbers.

### **Methodological Competence**

Students will be able to:

- o Execute vector operations and perform calculations with matrices and determinants.
- o Implement numerical methods to obtain solutions for engineering-related problems.
- o Transfer theoretical knowledge into practical applications through computational exercises and problem-solving tasks.
- o Demonstrate proficiency in software-based mathematical computation tools.
- o Organize and structure mathematical problem-solving strategies efficiently.
- o Apply mathematical modeling techniques to represent engineering systems and analyze their behavior.

### **Personal Competence**

Students will:

- o Develop an analytical and structured approach to problem-solving in mathematical contexts.
- o Enhance their ability to think critically and logically when tackling engineering problems.
- o Strengthen their ability to work independently and self-organize mathematical learning processes.
- o Gain confidence in using mathematical tools and techniques for engineering applications.

### **Social competence**

Students will:



- o Collaborate in small, multicultural teams to solve mathematical problems, enhancing teamwork and intercultural communication skills.
- o Discuss and communicate mathematical concepts effectively within a group setting.
- o Engage in peer discussions to verify and refine mathematical solutions.

### **Practical Components**

To ensure hands-on learning, the module includes:

Students work collaboratively in small groups during tutorial sessions to solve structured worksheets and engineering-related mathematical problems. Through numerical and graphical methods, they analyze mathematical structures, verify solutions, and enhance their problem-solving skills in a cooperative learning environment

### **Applicability in this and other Programs**

Mathematics is basic for most of engineering and scientific courses. This module lays the foundation on which most of the engineering and other scientific modules of the study program will be built.

### **Entrance Requirements**

Students are recommended to have prior knowledge of high school-level mathematics, including algebra, trigonometry, and elementary calculus.

### **Learning Content**

- o Basics: set theory, field of real numbers, logarithms, sums, inequalities and coordinate systems
- o Complex numbers
- o Vectors and Vector Algebra
- o Systems of Linear Equations, Matrices and Determinants
- o Sequences and Series of Real Numbers
- o Functions with one real variable
- o Curves and their Mathematical Representation
- o Introduction to Functions in more than variable

### **Teaching Methods**



- o Lectures, tutorials, and problem-solving sessions.
- o Hands-on exercises involving computational tools .
- o Weekly practical assignments and group discussions.
- o Online learning resources (iLearn) for supplementary material and self-study.
- o Interactive tutorial sessions integrating theory with real-world applications.

## Remarks

This module includes a significant amount of practical applications to strengthen students understanding of engineering mathematics through hands-on experience.

## Recommended Literature

- o Stroud, Kenneth A, Engineering mathematics, 7th edition, Palgrave Macmillan, 2013
- o Gilbert Strang., Introduction to linear algebra / 4th ed. Wellesley-Cambridge Press, c2009
- o Sterling K. Berberian, A first course in real analysis, Springer-Verlag, c1994
- o Berenstein, Roger Gay, Carlos A. Complex variables: an introduction, Springer-Verlag, c1991
- o J. Erven, D. Schwägerl, Mathematik für Ingenieure, Oldenbourg Verlag, 4. Auflage, 3. Auflage, 2010
- o W. Mückenheim, Mathematik für die ersten Semester, Oldenbourg Verlag, 3. Auflage, 2011

## IE-02 INFORMATICS FOR ENGINEERING I

Module code	IE-02
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Informatics for Engineering I
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Professional competence

##### Knowledge

- o Know and understand the basic principles of informatics (number systems, boolean logic, codes).
- o Know and understand the structure of computer systems.
- o Know and understand the fundamentals of programming languages (variables and commands).

##### Skills

- o Ability to handle, convert and calculate numbers in different number systems.
- o Ability to analyse networks and truth tables and to derive and simplify their boolean expressions.
- o Ability to derive algorithms for unknown problems.
- o Ability to transfer logical thinking into applied problem solution.

#### Personal competence



#### Social competence

- o Ability to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.
- o Ability to communicate with peers about a complex (and yet unknown) topic and find a joint approach to solving it.

#### Autonomy

- o Develop ability to self-study a complex and abstract topic.
- o Develop analytical thinking, attention to details and ability to consider different strategies to solve individually problems related to this lecture.
- o Develop judgement on the level of own skills.

### **Applicability in this and other Programs**

Bachelor Industrial Engineering

Bachelor Health Informatics

All similar technical or computer science related programs

### **Entrance Requirements**

No prerequisites besides school level math.

### **Learning Content**

- o History of informatics / computer science
- o Number systems
- o Conversion of number systems
- o Fractions and negative numbers in different number systems
- o Floating point numbers
- o Information and code types
- o Data types
- o Analog to digital conversion
- o Digital to analog conversion
- o Boolean logic
- o Disjunctive normal form

- o Network analysis and simplification
- o Registers and flip-flops
- o Von-Neumann principles and architecture
- o Machine code
- o Algorithms
- o Coding fundamentals
- o Networks
- o Hardware

## **Teaching Methods**

Lectures / exercises / tutorials / home work

PowerPoint presentation, whiteboard, document camera (visualiser) and additional lecture materials in iLearn

## **Recommended Literature**

Glenn Brookshear: Computer Science – An Overview, 11th ed, Addison-Wesley, 2010

Helmut Herold: Grundlagen der Informatik, 3. Ausgabe, Pearson, 2017

## IE-03 CHEMISTRY

Module code	IE-03
Module coordination	Prof. Dr. Raimund Brotsack
Course number and name	Chemistry Lab Work in Chemistry
Lecturer	Prof. Dr. Raimund Brotsack
Semester	1, 2
Duration of the module	2 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	6
ECTS	7
Workload	Time of attendance: 90 hours self-study: 120 hours Total: 210 hours
Type of Examination	Report, Portfolio, Präsentation 15 Min.
Duration of Examination	15 min.
Weighting of the grade	6/210
Language of Instruction	English

### Module Objective

Students learn about the basics of chemistry to understand the material composition of matter and to derive basic properties and behaviours.

#### Professional competence:

##### *Knowledge*

- o Students know the structure of matter at element and molecular level.
- o They are able to understand the language of chemistry (symbols, formula, equations, solution, concentrations).
- o Students understand the fundamental properties of elements and molecules and are able to establish simple reaction equations.
- o They are able to describe simple chemical reactions (Acid-Base Reactions, Redox reactions, simple organic reactions).
- o Based on their knowledge of the state and reaction possibilities of matter, students know the essential properties of water, metals, plastics, natural substances and energy raw materials.

- o Students understand the fundamentals of electrochemical cells, redox reactions and their importance to corrosion, batteries and electrochemical industry.
- o In the lab work part, students get introduced to gain experience in the conduct of laboratory experiments, the acquisition and treatment of data and report preparation.

#### *Skills*

- o Ability to understand chemical problems and translate them into equations and apply the principles of chemistry to solve the problems.
- o Ability to analyse the context of material based technical problems and to apply this to the design and development of technical systems and processes.
- o Ability to transfer the knowledge of chemical principles into understanding the behaviour of unknown systems.

#### **Method competences:**

After participating in this module, students will be able to understand and analyse material-based and substance-related aspects of products, processes and nature. They understand possible material-dependent challenges that arise in product and process development. In addition, students learn the first fundamental aspects about the climate and environmental relevance of materials.

#### **Social competence:**

- o Ability to work in intercultural mixed teams and communicate their progress and results.
- o Ability to communicate with peers about a complex topic and find a joint approach to solving it.

### **Applicability in this Program**

IE-29 Plant Engineering

IE-32 Project Work

IE-31 Renewable Energies

IE-17 Sustainability

### **Applicability in this and other Programs**

#### **This program**

IE-22 Renewable Energies

IE-23 Plant Engineering

IE-30 Sustainability

IE-32 Project Work

IE-Elective Process Engineering

### **Other programs**

ESE-05 Chemistry, BA Energy Systems Engineering at ECRI

D-1105 Chemie, BA Maschinenbau at THD

-1101 Chemie, BA Bauingenieurwesen at THD

Y-1101 Chemie, BA Umweltingenieurwesen at THD

N-09 / N2107 Chemie, BA Technische Physik at THD

## **Entrance Requirements**

Analytical Principles of Engineering (IE-01)

Physics (IE-11)

## **Learning Content**

- o Introduction to chemistry
- o The periodic table of elements
- o Atomic and molecular structure
- o Condition of substances, aggregate states, phase transformations, modification
- o Chemical bonding
- o Chemical reactions, reaction kinetics and thermodynamics
- o Principles of organic chemistry
- o Composition and properties of industrially important materials (metals, polymers, oil, coal, gas, glass, biomass)

## **Teaching Methods**

Course teaching / exercises / tutorials / experimental demonstrations and practical lab work in small teams

## **Remarks**

Laboratory work for the application and accompanying deepening of the knowledge learned in the lecture

## Recommended Literature

- o S.S. Zumdahl, S.A. Zumdahl, D. J. DeCoste; "Chemistry"; 10<sup>th</sup> edition; Cengage Learning; Boston; 2016
- o J.T. Moore, "Chemistry for dummies"; 2<sup>nd</sup> edition, Wiley; Hoboken; 2011
- o J.T. Moore, "Chemistry Essentials for dummies"; 2<sup>nd</sup> edition, Wiley; Hoboken; 2010
- o E.R. Riedl, H.-H. Meyer; "Allgemeine und anorganische Chemie"; De Gruyter, Berlin / Boston; 11. Auflage, 2013

## ► CHEMISTRY

### Objectives

Students learn about the basics of chemistry to understand the material composition of matter and to derive basic properties and behaviours.

Workload:

Time of attendance: 60 hours, self-study: 60 hours, Total: 120 hours

### Type of Examination

part of module exam, Portfolio

### Methods

seminaristic lectures

## ► LAB WORK IN CHEMISTRY

### Objectives

In the lab work part, students get introduced to gain experience in the conduct of laboratory experiments, the acquisition and treatment of data and report preparation.

Workload:

Time of attendance: 30 hours, self-study: 30 hours, Total: 60 hours

### Learning Content

- o Independently and autonomously planning of experiments
- o Documentation of experimental observations and results

- o Analysis and interpretation of experimental results as well as discussing errors
- o Improving intercultural cooperation and deepening social skills (group work)
- o Independent research on hazardous substances and substance properties in general.

### **Entrance Requirements**

Lecture Chemistry must be passed

### **Type of Examination**

report/presentation

### **Methods**

practical experiments in small groups from 2 up to 4 students

- o Own research on given topics in order to prepare experiments
- o own practical experiments in teams of 2 - 4 students in the chemistry lab
- o presentation and short discussion about the current experiments before practical realisation
- o supervision and support during experimental phase
- o discussion of results

## IE-04 PRINCIPLES IN BUSINESS AND ECONOMICS

Module code	IE-04
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Principles in Business
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	6
ECTS	5
Workload	Time of attendance: 90 hours self-study: 60 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

**This module aims to equip students with a foundational understanding of core business and economic principles and the ability to analyze related processes and interdependencies. The discussion of current topics and the practical relevance are ensured by the fact that the students prepare data and contexts from their home countries and present them to the audience.**

#### *Expertise*

- o Students understand and structure planning, decision-making, and control processes in companies from a practical perspective.
- o Students will know different forms of business ownership and the specifics of small businesses, entrepreneurship, and franchises.
- o Students are able to describe the operational functions systematically and explain interdependencies in a differentiated way.
- o Students will know and understand the development of central management approaches and the basic instruments in the management process.
- o Students understand aspects of attracting and retaining employees, as well as motivating and satisfying them and teams.

- o Students understand the environment of business, including ethical and social responsibility, and global business.
- o Students will know the ten principles of economics and the concept of interdependence and gains from trade.
- o Students have a basic understanding of microeconomic and macroeconomic analysis.
- o Students are able to recognize the interdependencies of markets and companies.
- o Students understand supply, demand, government policies, elasticity, consumer and producer efficiency, and the costs of taxation.
- o Students understand the basics of measuring a nation's income and externalities.

#### *Methodological Competence*

- o Students are able to apply economic models to corresponding questions with a view to current discussions.
- o Students are able to create basic economic analyses of a company's market environment.
- o Students are able to derive economic policy recommendations from the interdependencies of markets and companies.
- o Students are able to handle complex economic issues graphically, arithmetically, and verbally.
- o Students are able to work problem/solution-oriented.

#### *Personal Competence*

- o Students derive their own opinions by understanding the interplay between economic regulations, institutional framework, and the strategic profile of a company.
- o Students are able to handle tough work and study contexts independently and design them in an application-oriented way.
- o Students are strongly invited to discuss real-life problems and applications interactively throughout the lecture.
- o Students are able to relate their acquired knowledge to other lectures and topics.

#### *Social Competence*

- o Students develop communication skills supported by tasks and case studies.
- o Students are encouraged to discuss critical/controversial topics in an objective atmosphere.

- o Students are able to present their analyses in a goal-oriented and application-oriented manner matching the target audience.
- o Students are able to work in small mixed groups, learning and broadening teamwork abilities.

## **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of business and economic processes and interdependencies.

## **Entrance Requirements**

None.

## **Learning Content**

### **Business administration**

1. The environment of business
  - Being ethical and socially responsible
  - Global business
2. Business ownership and entrepreneurship
  - Different forms of business ownership
  - Small business, entrepreneurship, and franchises
3. Management and organization
  - Management process
  - Creating a flexible organization
4. Human resources
  - Attracting and retaining the best employees
  - Motivating and satisfying employees and teams

### **Economics**

1. Introduction
  - Ten principles of economics
  - Interdependence and the gains from trade
2. Markets and welfare
  - Supply, demand, and government policies
  - Elasticity
  - Consumers, producers, and the efficiency
  - Costs of taxation
3. The economics of the public sector
  - Externalities
4. Firm behavior and the organization of industry
5. The data of macroeconomics
  - Measuring a nation's income

## Teaching Methods

Seminaristic teaching combining lecture, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

## Remarks

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## Recommended Literature

### Basic literature

Pride W.M., Hughes R.J., Kapoor J.R.; "Foundations of Business"; Boston, MA: Cengage Learning.

Mankiw N.G.; "Essentials of Economics"; Boston, MA: Cengage Learning.

### Supplementary literature

Ebert R.J., Griffin R.W.; "Business Essentials"; Boston: Pearson Education.

Nickels W.G., McHugh J.M., McHugh S.M.; "Understanding Business"; New York: McGraw-Hill Education.

## IE-05 SCIENTIFIC WRITING, RESEARCH METHODS AND PROJECT MANAGEMENT

Module code	IE-05
Module coordination	Prof. Dr. Tobias Bader
Course number and name	IE-1205 Basics - Scientific Writing IE-2202 Scientific Writing, Research Methods and Project Management
Semester	1, 2
Duration of the module	2 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

Students are able to:

- o Assess interdisciplinary scientific research topics and applications
- o Describe project phases and project management methods
- o Discuss underlying theories of research models
- o Explain strategies of research problem analysis
- o Describe structure of scientific and technical publications

##### Skills

Students are capable to:



- o Address theoretical and/or experimental work for solving practice-oriented problems
- o Plan and structure project work and evaluate work in progress
- o Address research questions with quantitative research methods
- o Analyse data by applying different methods and critically evaluate and interpret the results
- o Employ software tools for data analysis, processing and scientific illustrations
- o Document scientific work and results, present and discuss them

### **Personal competence**

### **Social competence**

The students will be able to:

- o Apply concepts and models of intercultural communication for higher effectiveness in international environments
- o Communicate and collaborate successfully and respectfully with others in a team
- o Have constructive professional discussions
- o Do collaborative work on a small research project and deliver results
- o Present and defend the results of their work

### **Autonomy**

The students will be able to:

- o Apply theoretical concepts to practical applications
- o Read and understand scientific literature
- o Acquire knowledge in a specific context independently and to map this knowledge onto other problem fields

## **Applicability in this and other Programs**

Directly applicable in all modules involving reports, scientific presentations and writings as well as involving practical activities and project works (e.g. Applied Measurement and Control Engineering (IE-27), Project Work (IE-32), Bachelor Thesis (IE-37)).

## **Entrance Requirements**

None.

## Learning Content

The module provides the basics for developing skills and competences in applying scientific and research methods in both individual and collaborative working contexts focusing on:

- o Introduction to methods in scientific work
- o Code of ethics of engineers, plagiarism
- o Working in collaboration with others in a multicultural international environment
- o Procedures and phases of project management
- o Working efficiently, planning and scheduling
- o Risk analysis and management
- o Methodical and systematic approach to the handling of complex tasks
- o Introduction to quantitative research methods
- o Processing and presenting scientific data and results
- o Dissemination of results, written and oral communication
- o Practicing in teams addressing simple research questions under the form of small research projects
- o Writing technical reports and scientific papers
- o Oral presentation of the work and discussion of the results

## Teaching Methods

Seminaristic teaching / team work / self-reliant working / home work

Students are closely cooperating to carry out a small research project as a team work, training their competences acquired during their studies, and in the first part of the course, in a self-responsible and self-guided manner, fulfilling to specific tasks of the small projects.

Team work also includes promoting intercultural competence development by reflecting on personal identities and differences, principles of collective strength and advantages of being supported by a team. Addresses language used depending on the context, what favours and inhibits communication, how to deal with critical situations as well as on attributions, responsibilities within a collaborative team working.

## Recommended Literature

- o Kerzner Harold, Project Management: A Systems Approach to Planning, Scheduling and Controlling; 11th Ed., Wiley 2013
- o Kate L. Turabian, A Manual for Writers of Research Papers, Theses, and Dissertations, 8th Ed., Chicago Press 2013
- o Charles Lipson, How to Write a BA Thesis: A Practical Guide from Your First Ideas to Your Finished Paper, Chicago Press 2005
- o Dalgaard, P. Introductory statistics with R, Springer 2008
- o Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. Multivariate data analysis (Vol. 6). Upper Saddle River, Pearson 2006

## IE-06 ACCOUNTING

Module code	IE-06
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Accounting
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

**This module aims to provide students with a solid foundation in the principles and practices of accounting, focusing on financial accounting. Upon successful completion, students should be able to understand, apply, and analyze accounting information for various business decisions and stakeholder perspectives.**

#### *Expertise*

- o Students will know and understand the essential features of financial and management accounting as well as the legal foundations and components of bookkeeping and accounting.
- o Students will fully understand the operational functions of financial accounting and the informational expectations on financial accounting, enabling them to take the perspectives of all main stakeholders of a business.
- o Students will have a deep understanding of financial reports as a basic skill for business studies. They will know and understand the differences and linkages between the three main financial reporting statements.

- o Students will be able to evaluate the impact of business transactions on financial accounting, with a deep understanding of their effectiveness/neutrality on financial statements.
- o Students will be able to prepare and read financial statements and management reports.

#### *Methodological Competence*

- o Within the scope of double-entry bookkeeping, students will be able to execute accounting transactions independently.
- o By performing financial statement analyses, students will be able to assess the financial situation (profitability and financial risk) of a company applying the understanding gained before.
- o They will be able to analyze financial statements within the context of decision making.

#### *Personal Competence*

- o Students will be able to solve complex problems independently with application-related, fundamental knowledge of bookkeeping and accounting.
- o Students will be able to relate their acquired knowledge to other lectures and topics.
- o Students are encouraged to discuss critical/controversial topics in an objective atmosphere.
- o Students can present their analyses in a goal-oriented and application-oriented manner matching the target audience.

#### *Social Competence*

- o Students will develop communication skills that are supported by tasks and case studies. They will be familiar with the essential terminology of financial accounting and communicate about basic problems with other participants using the appropriate technical terms.
- o Students will be able to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.
- o Students can present their analyses in a goal-oriented and application-oriented manner matching the target audience.

### **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of bookkeeping, accounting and the assessment of the financial situation of a company.

## **Entrance Requirements**

None.

## **Learning Content**

1. Accounting: information for decision making
2. Basic financial statements
3. The accounting cycle
  - Capturing economic events
  - Accruals and deferrals
  - Reporting financial results
4. Financial statement analysis

## **Teaching Methods**

Seminaristic teaching combining lecture, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

## **Remarks**

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## **Recommended Literature**

### **Basic literature**

Williams J.R., Haka S.F., Bettner M.S., Carcello J.V.; "Financial & Managerial Accounting: The Basis for Business Decisions"; New York: McGraw-Hill Education.

### **Supplementary literature**

Dyson J.R., Franklin E.; "Accounting for Non-Accounting Students"; Harlow: Pearson Education.

McLaney E., Atrill P.; "Accounting and Finance: An Introduction"; Harlow: Pearson Education.

## IE-07 FOREIGN LANGUAGE I

Module code	IE-07
Module coordination	Tanja Mertadana
Course number and name	Foreign Language I
Lecturer	Dozierende für AWP und Sprachen
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	4
Workload	Time of attendance: 60 hours self-study: 60 hours Total: 120 hours
Type of Examination	See examination schedule AWP and languages, written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	4/210
Language of Instruction	English

### Module Objective

The module Foreign Language I aims to equip students with specialized language skills necessary for independent performance in a globalized Industrial Engineering sector. In doing so, it strives to deepen students' relationship with the respective language in business settings so that they can effectively and efficiently implement the language as a practical communication tool.

The module covers the four basic language skills - listening, reading, speaking and writing. Students expand their subject-specific vocabulary and deepen their knowledge of the language structures.

The main focus of the module is to optimise fluency and improve the ability to communicate in the respective language in order to clearly understand and explain complex texts and conversations in professional context. Through task-based speaking, listening, reading and writing activities, students optimise their communicative skills and develop their ability to express themselves. This enables them to participate in expert discussions, work in a team, prepare relevant documents independently and in a competent manner and to give successful presentations in the respective language.

For international students without completed and certified German B2 proficiency Foreign Language I means German as a Foreign Language.

For students at German level C1 (completed and certified German B2) Foreign Language I means an English course that is an integral part of the curriculum.

### **General Business English B2/C1:**

On completion of the module students will have achieved the following learning objectives:

#### Subject-specific skills

At Level B2/C1, students should be able to:

- o have an independent command of specialized business terminology. Command here refers to oral and written production and to aural and reading comprehension.
- o They will have gained the skills to understand specialised literature and to produce texts autonomously at a B2/C1 level.
- o They will have gained essential experience in presenting topics related to business English. The goal here is to include niche knowledge in the protocols of a clearly structured, effectively delivered piece of public speaking.
- o They will be able to understand discussions and complex content in their area of specialisation.
- o They will develop the ability to functionally apply grammatical structures in their future professional fields.

#### Methodological skills

Methodological skills refer to the students' ability to use a variety of learning and working methods to further develop their linguistic and subject-specific knowledge

- o Students will have expanded their language acquisition skills by reflecting their individual styles of learning.
- o They will be able to filter information from different English sources and use it for their presentations.

#### Social skills

Social skills refer to students' ability to conduct themselves appropriately, communicating effectively and working in groups when engaging in social interactions.

- o Students will have gained valuable experience in training other personal skills such as teamwork, reliability and negotiation skills.

- o They will have reflected on the learning benefits derived from several independent projects.
- o They will have the communicative skills to collaborate with others to find solutions.

#### Personal skills

Personal skills refer to students' individual abilities, attitudes and traits that enable them to achieve their goals, further their personal development and work successfully.

- o Transfer of profound language and social skills, which are of fundamental importance for personal development and the future work environment.
- o Flexibility and adaptability in order to be prepared to respond to new requirements and changes.
- o Problem-solving skills and the ability to find innovative solutions.

#### **German as a Foreign Language:**

The learning objectives can be found in the corresponding course description on the homepage of the Language Centre:

<https://www.th-deg.de/en/students/language-electives#german>

### **Applicability in this and other Programs**

Applicable in other degree programmes: ESE-1, HI-1, ITM-1

### **Entrance Requirements**

#### **General Business English B2/C1:**

The prerequisite for successful participation in the module is a command of the English language at B2 level, based on the Common European Framework of Reference for Languages (CEFR).

#### **German as a Foreign Language:**

When registering for a course, the students' German language skills are assessed. Depending on the results, students are allocated to a course corresponding to their level. After successful completion of a course, students can attend an advanced German course.

### **Learning Content**

#### **General Business English B2/C1:**

- o Business Basics

- o Company Structures
- o Management and Leadership
- o Start-ups Businesses
- o Innovation and Technology in Business
- o E-commerce
- o Marketing and Advertising
- o Forecasting and Planning
- o Project Management
- o Communication and Business Correspondence
- o Business Meetings and Presentations
- o Working Across Cultures
- o Workplace Atmosphere
- o Current Business Topics
- o Grammar and Vocabulary Reviews
- o Understanding and Using Idiomatic English

### **German as a Foreign Language:**

The course content can be found in the corresponding course description on the homepage of the Language Centre:  
<https://www.th-deg.de/en/students/language-electives#german>

## **Teaching Methods**

The teaching methods applied will focus on optimising the four main language skills (listening, speaking, reading and writing). Examples of the applied learning methods include various forms of group, individual and collaborative work, mini-presentations, exercises involving intensive reading and listening, role plays and grammar games, loci method, dictation exercises, translations, peer feedback, working with learning stations, and various writing activities designed to consolidate the content learnt.

Students will be given weekly assignments for self-study.

## **Remarks**

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

## Recommended Literature

### General Business English B2/C1:

Baade, K. *Business Result: Advanced, Second Edition*, Oxford: OUP, 2017.

Brook-Hart, Guy. *Business Benchmark*. 2nd ed.: Upper Intermediate. Cambridge: CUP, 2013.

Butzphal, G., Maier-Fairclough, J. *Career Express. Business English B2*. Berlin: Cornelson, 2015.

Cotton, D., Falvey, D. & Kent, S. *Market Leader Upper Intermediate*. Harlow: Pearson Longman, 2016.

Duckworth, M., Turner, R. *Business Results Upper Intermediate*. Oxford: OUP, 2008.

Emmerson, P. *Business Vocabulary Builder*. London: Macmillian, 2009.

Emmerson, P. *Business Grammar Builder. Intermediate to Upper-intermediate*. London: Macmillian, 2010.

Foley, M., Hall, D. *MyGrammarLab. Intermediate B1/B2*. Harlow: Pearson, 2012.

Hughes, J. *Business Result: Upper-Intermediate, Second Edition*, Oxford: OUP, 2020

Law, Jonathan. *A Dictionary of Business and Management*. 6th ed. Oxford: OUP, 2016.

Rogers, Louis. *Skills for Business Studies*. Upper Intermediate. Oxford: OUP, 2012.

Vince, Michael. *Intermediate Language Practice*. 3rd ed. London: Macmillan, 2010.

'The Economist' weekly newspaper.

### German as a Foreign Language:

Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:

<https://www.th-deg.de/en/students/language-electives#german>

## IE-08 MATHEMATICS FOR ENGINEERING

Module code	IE-08
Module coordination	Ibrahim Bader
Course number and name	Mathematics for Engineering
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5 / 210
Language of Instruction	English

### Module Objective

#### Module Objective

This module equips students with the fundamental mathematical skills necessary for engineering applications. It covers essential concepts in calculus, differential equations, and mathematical modeling, providing a strong foundation for solving real-world engineering problems.

#### Professional Competence

##### Expertise

Upon successful completion of this module, students get to:

- o Recognize and apply the fundamental concepts of theoretical mathematics and calculus.
- o Identify and describe elementary functions, partial differentiation, and ordinary differential equations.
- o Understand and apply the Fundamental Theorem of Calculus.
- o Explain the role of mathematical modeling in engineering and business applications.

- o Evaluate and apply mathematical techniques to solve engineering problems effectively.

### **Methodological Competence**

Students will be able to:

- o Compute limits of basic functions and analyze continuity.
- o Differentiate functions of one or more variables and apply differentiation techniques.
- o Solve first-order ordinary differential equations using analytical and numerical methods.
- o Perform partial differentiation and manipulate derivatives of multivariable functions.
- o Compute and analyze infinite and finite integrals, including multiple integrals.
- o Obtain numerical solutions to engineering and real-life problems using differential and integral methods.
- o Expand periodic functions using Fourier Series.
- o Apply mathematical concepts to engineering case studies and practical scenarios.

### **Personal Competence**

Students will develop:

- o Independent problem-solving abilities through structured exercises and applications.
- o Logical reasoning and critical thinking skills in mathematical problem-solving.

### **Social Competence**

Students will:

- o Collaborate in small, diverse groups to solve mathematical problems, enhancing teamwork and communication skills.
- o Engage in multicultural learning environments, strengthening intercultural competence.

### **Practical Components**

Students apply mathematical methods to solve real-life engineering problems through structured worksheets and exercises. They practice numerical problem-solving and analytical thinking in practical contexts relevant to engineering.

## **Applicability in this and other Programs**

Mathematics is essential for most engineering and scientific courses. This module, together with Analytical Principles of Engineering and Applied Mathematics, establishes a foundation for advanced engineering and scientific studies.

## **Entrance Requirements**

IE-01 Analytical Principles of Engineering

## **Learning Content**

- o Functions and Limits (functions in one variable)
- o Differentiation (functions in one variable)
- o Applications on derivatives
- o Integration
- o Power Series
- o Basics of differential geometry for plane curves
- o Area calculation of plane regions (bounded by a number of curves)
- o Differentiation of functions with several variables
- o Multiple integrals (domain, region, area and volume integration)
- o Fourier-Series
- o Introduction to Power Series

## **Teaching Methods**

- o Lectures, exercises, tutorials, homework, and group activities.
- o Use of whiteboard, visualizer, online learning portal (iLearn), and active learning methods.
- o Weekly hands-on exercise sessions incorporating real-life engineering applications.

## **Remarks**

This module includes a significant amount of practical applications to strengthen students understanding of engineering mathematics through hands-on experience.

## **Recommended Literature**

- o Dwivedi, A.P, Engineering mathematics, PHI Learning Private Limited, New Delhi, 2015
- o James, Glyn, Advanced modern engineering mathematics, Fifth edition, Pearson, 2018
- o Harvey P. Greenspan, David J. Benney, Calculus: an introduction to applied mathematics, Breukelen Press, c1997
- o Anton Howard, Calculus: with analytical geometry, 5th ed. Wiley, 1995
- o Sterling K. Berberian, A first course in real analysis, Springer-Verlag, c1994
- o K. Dürrschnabel, Mathematik für Ingenieure, Springer Verlag, 2. Auflage, 2012
- o T. Westermann, Mathematik für Ingenieure, Springer Verlag, 6. Auflage, 2011

## IE-09 INFORMATICS FOR ENGINEERING II

Module code	IE-09
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Informatics for Engineering II
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Professional Competence

##### *Knowledge*

- o Know and understand the basic principles, commands and syntax of the Python programming language
- o Know and understand the structure of computer programs
- o Know and understand how to write a program in computer code
- o Know and understand different programming paradigms and styles

##### *Skills*

- o Ability to implement different algorithms and methods in a computer program
- o Ability to understand and debug computer programs
- o Ability to structure problems and create solutions for given tasks in computer code
- o Ability to write computer code using different programming styles, i.e. procedural, object oriented or event driven that are the best suited to the programming task
- o Ability to create graphical user interfaces for given tasks

## **Personal Competence**

### *Social competence*

- o Ability to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.
- o Ability to communicate with peers about a complex (and yet unknown) topic and find a joint approach to solving it.

### *Autonomy*

- o Develop ability to use online resources to learn syntax and methods of python programming.
- o Develop ability to design criteria and testing strategies to check quality of own work.
- o Gain experience in time-boxed problem solution.

## **Applicability in this and other Programs**

All similar study programs.

## **Entrance Requirements**

IE-02 Informatics for Engineering I (or similar course)

## **Learning Content**

- o Programming languages, syntax and semantics
- o Program execution, compilers and interpreters
- o Program structure and general programming guidelines
- o Python, an interpreted, high-level, general-purpose programming language
- o Variable data types, casting
- o Numbers, strings, booleans
- o Operators, expressions
- o Lists, tuples, sets and dictionaries
- o Loops and conditionals
- o Named and anonymous functions
- o Programming paradigms: procedural and object oriented programming

- o Classes and Objects
- o Object properties, methods, object constructor method
- o Inheritance, encapsulation
- o Modules and external libraries: Math, Numpy, Matplotlib, Selenium
- o User input, output, formatting
- o File and internet data handling
- o Graphical user interfaces and event driven programming

## Teaching Methods

Lectures / exercises / tutorials / home work

PowerPoint presentation, whiteboard, excel and visual basic exercises, document camera (visualiser) and additional lecture materials in iLearn

## Remarks

Python will be the main language in this class employed on the following platforms:

- Anaconda Data Science Platform : Spyder or PyCharm IDEs
- Online: <https://repl.it> , <https://edabit.com>

## Recommended Literature

- o Learn to Program with Python: Take your first steps in programming and learn the powerful Python programming language, Irv Kalb, Apress 2016  
<https://ebookcentral.proquest.com/lib/th-deggendorf/reader.action?docID=4652556>. Download source code from:  
<https://github.com/apress/learn-to-program-w-python>
- o Python Projects for Beginners: A Ten-Week Bootcamp Approach to Python Programming, Connor P. Milliken, Apress 2020  
<https://link.springer.com/book/10.1007%2F978-1-4842-5355-7>. Download source code from: <https://github.com/Apress/python-projects-for-beginners>
- o Massachusetts Institute of Technology (MIT) OpenCourseWare : Introduction to Computer Science and Programming <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/>
- o Python tutorials on:
  - o <https://www.w3schools.com/python/default.asp>

- o [https://www.python-course.eu/python3\\_course.php](https://www.python-course.eu/python3_course.php)

## IE-10 TECHNICAL MECHANICS I

Module code	IE-10
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Technical Mechanics I
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

- o Understanding the theories and methods of engineering mechanics, statics of structures and beams.
- o Understanding mechanical properties of materials, their strengths and elastic properties.
- o Knowledge of basic principles and methods for analysing mechanical systems and application of that integrated knowledge to practical problems of mechanical engineering.

##### Skills

- o Students are able to apply theories and methods to calculate:
- o Systems of concentrated and distributed forces, moments and couples for mechanical structures.
- o Mechanical systems in static equilibrium and limits of equilibrium conditions.
- o External and internal effects on loaded beams.

- o Deformations (1D) based on simple stresses and material data.

### **Personal competence**

#### Social competence

- o Students are able to work goal-oriented in small mixed groups, learning and broadening teamwork abilities.

#### Autonomy

- o Develop analytical thinking, attention to details and ability to consider different strategies to solve individually problems related to this lecture.

## **Applicability in this and other Programs**

The module provides basic knowledge for other courses of different study programs that require engineering mechanics fundamentals.

## **Entrance Requirements**

Knowledge of elementary mathematics and physics is recommended.

## **Learning Content**

Engineering mechanics, statics of structures and beams, mechanical properties of materials, their strengths and elastic deformations with particular focus on:

- o Definitions, Newton's laws, fundamental terms and units, scalars and vectors, force, moment of a force.
- o Vectors, properties, trigonometric functions, unit vectors, addition, subtraction, dot and cross products.
- o System of forces, principle of transmissibility, rectangular components, moment of a force, Varignon's theorem, couples, resultant of system of forces.
- o Equilibrium conditions, free body diagrams, support reactions.
- o Distributed forces, center of gravity, center of mass, centroids, composite techniques, beams subjected to distributed forces.
- o Internal effects, sign conventions, normal, shear and bending moment, internal effect diagrams.
- o Stress calculations, material strength, yield and admissible stress, normal and shear stress, bending stress, area moment of inertia, elastic section modulus.
- o Deformation, Hookes law, deflection of beams, curvature, slope and elastic curve equations.

- o Friction, static friction, impending motion and kinetic friction, belt friction.

## Teaching Methods

Lectures / exercises / tutorials / home work

PowerPoint presentation, whiteboard, document camera (visualiser) and additional lecture materials in iLearn

## Recommended Literature

- o Engineering Mechanics - Vol. 1: Statics, 2nd ed. by D. Gross, W. Hauger, J. Schröder, W. A. Wall, N. Rajapakse, Springer 2013
- o Engineering Mechanics - Vol. 2: Mechanics of Materials, 1st ed., D. Gross, W. Hauger, J. Schröder, W. A. Wall, J. Bonet, 2011
- o Mechanics of Materials, 8th ed. by Russell C. Hibbeler, 2011
- o Engineering Mechanics: Statics 8th ed. by James L. Meriam, L. G. Kraige
- o Aufgabe zu Technische Mechanik 1-3: Statik, Elastostatik, Kinetik 8th ed. by W. Hauger, V. Mannl, W. A. Wall, E. Werner, 2014

## IE-11 PHYSICS

Module code	IE-11
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	IE-2206 Physics IE-3201 Lab Work in Physics
Semester	2, 3
Duration of the module	2 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	6
ECTS	7
Workload	Time of attendance: 90 hours self-study: 120 hours Total: 210 hours
Type of Examination	Report, Präsentation 15 Min. , written ex. 90 min.
Duration of Examination	105 min.
Weighting of the grade	7/210
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

- o Understand, that physics' laws are at the fundamental basis for every technology.
- o Know the fundamental laws and principles of physics.
- o Know the physical approaches of using boundary conditions, conservation laws or equilibrium conditions to describe systems and solve problems.

##### Skills

- o Ability to structure physical problems and translate them into equations and apply the principles of physics to solve the problems.
- o Ability to analyse the context of complex technical problems and to apply this to the design and development of technical systems and processes.
- o Ability to transfer the knowledge of physics principles into understanding the behaviour of unknown systems.

- o Ability to plan and conduct experiments.
- o Ability to evaluate and explain the results of experiments.

### **Personal competence**

#### Social competence

- o Ability to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.
- o Ability to communicate with peers about a complex (and yet unknown) topic and find a joint approach to solving it.
- o Ability to coordinate small teams for experiment execution and lab report preparation.

#### Autonomy

- o Develop ability to self-study a complex and abstract topic.
- o Develop analytical thinking, attention to details and ability to consider different strategies to solve individually problems related to this lecture.
- o Develop judgement on the level of own skills.

## **Applicability in this and other Programs**

Applicable in Bachelor Health Informatics and all similar study programs.

## **Entrance Requirements**

Advanced mathematics (Analytical Principles of Engineering IE-01)

## **Learning Content**

- o History and Origin of Physics
- o Unit Systems (SI)
- o The Newton laws of motion
- o Motions in several dimensions
- o Equations of motion
- o Force and Work
- o Work and Energy
- o Conservative and non-conservative forces

- o Energy conservation
- o Mechanics of mass points and systems
- o Linear momentum
- o Conservation of linear momentum
- o Collisions
- o Friction
- o Circular motion
- o Torque
- o Moment of inertia
- o Angular momentum
- o Conservation of angular momentum
- o Center of mass concept
- o Fundamentals of fluid mechanics
- o Fundamentals of thermodynamics
- o Phase transitions
- o Temperature, pressure, entropy
- o The laws of thermodynamics
- o Thermodynamic processes

## Teaching Methods

Lectures / exercises / tutorials / home work / lab work

PowerPoint presentation, whiteboard, document camera (visualiser) and additional lecture materials in iLearn

## Recommended Literature

The course will be mainly based on:

David Halliday, Robert Resnick, Jearl Walker. *Principles of Physics*. 10th edition. Hoboken, NJ: Wiley. (2014)

All other books on Physics (namely for engineering) are suited as well.



## IE-12 COMPULSORY ELECTIVE SUBJECT OF A GENERAL ACADEMIC NATURE (AWP) I

Module code	IE-12
Module coordination	Tanja Mertadana
Course number and name	AWP I
Lecturer	Dozierende für AWP und Sprachen
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	2
ECTS	2
Workload	Time of attendance: 30 hours self-study: 30 hours Total: 60 hours
Type of Examination	See examination schedule AWP and languages
Weighting of the grade	2/210
Language of Instruction	English

### Module Objective

This AWP (compulsory elective subject of a general academic nature) elective module enables students to acquire knowledge and skills in subject areas beyond the scope of their chosen degree programme.

Students can choose both face-to-face courses and courses offered by the Virtuelle Hochschule Bayern (VHB). Students acquire knowledge and skills in the following areas:

- o in a foreign language (language skills)
- o in the didactic-pedagogical area (methodological skills)
- o in the social sciences (social skills)
- o in the psychological-sociological field (social skills)
- o in the technical and scientific field (professional skills)
- o in the philosophical-social-ethical area (personal skills)

Students at German level C1 (completed and certified German B2) are free to choose their courses from the list of elective (AWP) courses offered to expand their knowledge according to their own preferences.

For international students without completed and certified German B2 proficiency AWP I means German as a Foreign Language.

## **Applicability in this and other Programs**

Applicable in other degree programmes.

## **Entrance Requirements**

Elective (AWP) courses: Elective (AWP) courses may not have any overlapping content with the student's current degree programme.

German as a Foreign Language + Other languages: For advanced language courses, students have to prove the required language skills (for example through successful completion of a lower level, certificates, placement test).

## **Learning Content**

The course content can be found in the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

## **Teaching Methods**

The teaching and learning methods can be found in the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

## **Remarks**

For course-specific details, please refer to the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

electives#german

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

## **Recommended Literature**

Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

## IE-13 FOREIGN LANGUAGE II

Module code	IE-13
Module coordination	Tanja Mertadana
Course number and name	Foreign Language II
Lecturer	Dozierende für AWP und Sprachen
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	2
ECTS	2
Workload	Time of attendance: 30 hours self-study: 30 hours Total: 60 hours
Type of Examination	written ex. 60 min.
Duration of Examination	60 min.
Weighting of the grade	2/210
Language of Instruction	English

### Module Objective

The module Foreign Language II aims to equip students with specialized language skills necessary for independent performance in a globalized Industrial Engineering sector. In doing so, it strives to deepen students' relationship with the respective language so that they can effectively and efficiently implement the language as a practical communication tool.

The module covers the four basic language skills - listening, reading, speaking and writing. Students expand their subject-specific vocabulary and deepen their knowledge of the language structures.

The main focus of the module is to optimise fluency and improve the ability to communicate in the respective language in order to clearly understand and explain complex texts and conversations in professional context. Through task-based speaking, listening, reading and writing activities, students optimise their communicative skills and develop their ability to express themselves. This enables them to participate in expert discussions, work in a team, prepare relevant documents independently and in a competent manner and to give successful presentations in the respective language.

For international students without completed and certified German B2 proficiency Foreign Language II means German as a Foreign Language. Students at German level C1 (completed and certified German B2) can choose between different languages available for selection. The course offer varies each semester.

The learning objectives can be found in the corresponding course description on the homepage of the Language Centre:

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://www.th-deg.de/en/students/language-electives#languages>

## **Applicability in this and other Programs**

Applicable in other degree programmes.

## **Entrance Requirements**

For advanced language courses, students have to prove the required language skills (for example through successful completion of a lower level, certificates, placement test).

## **Learning Content**

The course content can be found in the corresponding course description on the homepage of the Language Centre:

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://www.th-deg.de/en/students/language-electives#languages>

## **Teaching Methods**

The teaching methods applied will focus on optimising the four main language skills (listening, speaking, reading and writing). Examples of the applied learning methods include various forms of group, individual and collaborative work, mini-presentations, exercises involving intensive reading and listening, role plays and grammar games, loci method, dictation exercises, translations, peer feedback, working with learning stations, and various writing activities designed to consolidate the content learnt.

Students will be given weekly assignments for self-study.

## **Remarks**

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

## **Recommended Literature**

Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://www.th-deg.de/en/students/language-electives#languages>

## IE-14 APPLIED MATHEMATICS

Module code	IE-14
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Applied Mathematics
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

**This module aims to equip students with a strong foundational understanding of statistical methods and data handling techniques. Upon successful completion, students will be able to apply these methods to gain relevant business and economic insights, critically interpret statistical information, and work effectively in teams to solve application-oriented problems. With the help of MS Excel, students address current practical problems.**

#### *Expertise*

- o Students will know and understand different statistical methods based on their capability, assumptions, and limitations.
- o Students understand the concepts of displaying and describing categorical and quantitative data, as well as correlation and linear regression.
- o Students will know the principles of modeling with probability, including random variables and probability models, and the normal and other continuous distributions.
- o Students understand the concepts of surveys and sampling, as well as sampling distributions and confidence intervals for proportions.

### *Methodological Competence*

- o Students are able to select suitable statistical methods appropriate to specific (research) problems.
- o Students are able to gain relevant business and economic information and insights from unstructured data with the help of appropriate structuring, consolidation, graphical processing, and calculation of parameters.
- o Students can make corresponding analyses both manually and with the help of appropriate software packages.
- o Students can critically interpret own and existing statistics from internal or external sources.
- o Students are able to carry out their own empirical project work and derive recommended actions for the client.

### *Personal Competence*

- o Students can self-responsibly deal with unstructured data and select appropriate statistical models.
- o Students are able to handle complex work and study contexts independently and design them in an application-oriented way.
- o Students are able to relate their acquired knowledge to other lectures and topics.

### *Social Competence*

- o Students can work in small work groups defined to solve (research) problems and case studies, fostering a team-oriented working style.
- o Students can explain and defend their results in front of the class.
- o Students are able to explain their assessment of alternative courses of action and impugn the plausibility of using models.
- o Students' discussion and presentation skills in the academic context are strengthened through the interactive character of the lectures and tutorials.

## **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of statistical methods and handling of data.

## **Entrance Requirements**



Analytical Principles of Engineering (IE-01) and Mathematics for Engineering (IE-07) are recommended.

## Learning Content

1. Exploring and collecting data
  - Displaying and describing categorical and quantitative data
  - Correlation and linear regression
2. Modeling with probability
  - Random variables and probability models
  - The normal and other continuous distributions
  - Surveys and sampling
  - Sampling distributions and confidence intervals for proportions
3. Inference for Decision Making
  - Testing hypotheses about proportions
  - Confidence intervals and hypothesis tests for means

## Teaching Methods

Seminaristic teaching combining topic-oriented lectures, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

The seminar is accompanied by tutorials where calculation examples from the course are repeated for better understanding and examples similar to those used during course sessions are calculated.

## Remarks

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## Recommended Literature

### Basic literature

Sharpe N.R., De Veaux R.D., Velleman P.F.; "Business Statistics"; Harlow: Pearson Education.

Levine D.M., Stephan D.F., Szabat K.A.; "Statistics for Managers Using Microsoft Excel"; Harlow: Pearson Education.

### Supplementary literature

Groebner D.F., Shannon P.W., Fry P.C.; "Business Statistics"; Harlow: Pearson Education.

Barrow M.; "Statistics for Economics, Accounting and Business Studies"; Harlow: Pearson Education.

## IE-15 FUNDAMENTALS OF ELECTRICAL ENGINEERING

Module code	IE-15
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Fundamentals of Electrical Engineering
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

Students are able to explain and reproduce basic theories, principles, and methods related to:

- o Fundamental relations between electrical quantities
- o Basic components: sources, resistance, capacitor and inductor
- o Electrical circuits and fundamental effects that may occur within electrical circuits and networks
- o Network theorems and network analysis methods
- o Transient analysis of electrical circuits and application of the Laplace transform for transient analysis
- o Steady dc and ac analysis, complex representations and phasor diagrams
- o Fundamental elements and parameters of electrical power supply

## **Skills**

Students are capable of:

- o Applying theoretical concepts to practical applications
- o Applying general methods for the analysis of electrical networks
- o Calculating parameters of simple electrical networks
- o Calculate networks with sinusoidal excitations applying the complex calculation methods
- o Using the Laplace transform to compute transients with initial conditions and work with correspondence tables
- o Applying simulation tool SPICE for the simulation of simple stationary and unsteady problems
- o Dimensioning circuit elements by means of a design
- o Implementing simple measurements, working with instruments: multimeters, signal generators and oscilloscope

## **Personal competence**

### **Social competence**

Students can analyse and solve problems in small groups, can compare theoretical results with experiments and discuss it within the group. Present the related topics to professionals and discuss and argue for the obtained results.

### **Autonomy**

The students are able to acquire skills outside their lectures from literature as well as and can solve problems by their own. They are able to relate their acquired knowledge to other lectures.

## **Applicability in this and other Programs**

The module provides basic competences for other courses of different study programs that require electrical engineering fundamentals (e.g. for: Fundamentals of Measurement and Control Engineering (IE-26), Plant Engineering (IE-23), Industrial Automation and Information Technology, Data Acquisition and Processing, etc.

## **Entrance Requirements**

Analytical Principles of Engineering (IE-01) as well as Mathematics for Engineering (IE-07) and Physics (IE-11) are recommended.

## Learning Content

The module provides introduction to the fundamentals of electrical engineering addressing:

- o Physical electrical quantities, dc and ac signals
- o Circuit components: sources, resistors, capacitors and inductors
- o Circuits: series, parallel, star and delta connections
- o Ohm's law, electrical dc power and energy
- o Kirchhoff's laws
- o Network theorems: Thévenin, Norton, Superposition
- o Network analysis: mesh current and nodal voltage methods
- o Transient analysis using Laplace transform
- o AC circuits and components with sinusoidal excitation
- o Apparent, reactive and active ac power, power factor
- o Phasors and phasor diagrams
- o Complex representations and calculation of ac circuits
- o Transfer functions, logarithmic scales, Decibels and Bode-plot
- o Simple filters

Practical laboratory experimental sessions are enabling the students to consolidate the theoretical knowledge as well as to develop practical skills in addressing and handling electrical circuits and equipment.

## Teaching Methods

Seminaristic teaching / exercises / home work

Whiteboard, PowerPoint presentation, document camera (visualiser) and additional lecture materials in iLearn

Experiments in small groups using training material that relays on professional computer-based experimentation system where multimedia combines cognitive and hands-on training units into a comprehensive unified concept enabling students to consolidate theoretical building blocks and practical skills for a maximum learning effectiveness.

## Recommended Literature



- o Electrical Engineering: Principles and Applications, 7th International Edition, Allan R Hambley, Pearson 2018
- o Hughes Electrical and Electronic Technology, 12/E, Edward Hughes, John Hiley, Ian McKenzie-Smith, Keith Brown, Pearson 2016
- o Grundgebiete der Elektrotechnik 1/2, Horst Clausert, Gunther Wiesemann, Volker Hinrichsen, Jürgen Stenzel, Oldenbourg Wissenschaftsverlag 2014/2009
- o Moeller Grundlagen der Elektrotechnik, 23 Auflage, Thomas Harriehausen, Dieter Schwarzenau, Springer Vieweg 2013
- o Computer-based training material and experimentation systems on Electrical Engineering, UniTrain Course and Systems, Lucas-Nülle - <https://www.lucas-nuelle.com/>

## IE-16 INTERCULTURAL MANAGEMENT

Module code	IE-16
Module coordination	Prof. Dr. Michelle Cummings-Koether
Course number and name	Intercultural Competences
Lecturers	Prof. Dr. Michelle Cummings-Koether Franziska Durner
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 80 hours virtual learning: 10 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Module Objective

Intercultural differences can affect the ability to constructively work together in international environments. Often those differences are not recognized until after misunderstandings have already begun. In the field of engineering, this differences not only affect the ability to work together, but can also affect the quality of the product that is being designed or built. Many conflicts in international teams can be led back to cultural differences, and the ability to recognize the causes of these conflicts, as well as the ability to rationalize different possibilities to solve these conflicts, is an essential part of being culturally competent. This is why the importance of intercultural management skills is necessary to effectively lead intercultural teams in an ever increasing internationalized work environment.

This ability to recognize and respond appropriately to cultural differences can help lead to more successful working relationships. Intercultural competence is the ability to recognized one's own cultural patterns, and the ability to respond to others cultural patterns in the best way possible for both sides, and to find way to reduce misunderstandings and conflicts for future cultural interactions.

After completing the course, the students are expected to have the following competences and skills.

### **Professional competence and skills:**

- o Develop knowledge and understanding of key theories, concepts and models in intercultural communication and management
- o Familiar with different cultural theory models, and how to apply these to various work environments
- o The ability to work with other cultures on a common level of understanding, based on an analysis of commonalities and differences
- o To be more effective in international environments
- o To better understand and solve cultural problems, and to recognize how these affect international working environments
- o To recognize how stereotypes and prejudice play into interactions between cultures
- o The ability to differentiate between the different types of cultures

### **Method competence:**

The students are able to understand how cultures develop and change over time. They can look at certain behavior in a certain culture, and are able to recognize what cultural standards are driving this behavior, thus being able to adapt their own behavior to be able to react appropriately. They are able to analyze the effectiveness of working with others on various levels, that go beyond skill sets, and look for cultural patterns that work well with their own patterns.

### **Personal and social competences:**

- o The ability to understand one's own cultural patterns and attitude
- o The possibility to increase one's own tolerance for cultural differences
- o Increased cultural and emotional intelligence

## **Applicability in this and other Programs**

The students will be able to work more effectively in international environments and to communicate more effectively with colleagues from cultures other than their own. They will learn management skills for international environments.

Students will be more equipped to successfully solve intercultural problems and conflicts, as well as potential miscommunication in engineering processes, due to cultural communication differences.

Increased cultural and emotional intelligence will help them to recognize potential problems and conflicts more effectively, and give them the ability to deescalate these more effectively and quickly.

## **Entrance Requirements**

Fluent in English and some intercultural experience recommended.

## **Learning Content**

Content of the course:

- o Defining what culture is
- o Recognizing cultural patterns
- o Responses to other cultures
- o How culture functions
- o Organizational Culture
- o Different layers of culture
- o How to create new cultural patterns in organizations
- o Leadership and management in intercultural settings
- o Cultural and emotional intelligence

More topics can be added depending of progress of the discussion, or to include current events.

## **Teaching Methods**

Interactive teaching in a seminar environment / group exercises / case studies / presentations

## **Recommended Literature**

Recommended reading (if possible in the most current edition):

1. Hall, E. T., Hall, M. R. (2015). Understanding Cultural Differences. Yarmouth: Intercultural Press.
2. Laroche, L. (2011). Managing cultural diversity in technical professions. London: Routledge.

3. Mahadevan J., Primecz H., Romani L. (2020). Cases in critical cross-cultural management : an intersectional approach to culture. New York: Routledge, Taylor & Francis Group
4. Meyer, E. (2016). The Culture Map. New York: Public Affairs.
5. Molinsky, A. (2013). Global Dexterity: How to Adapt Your Behavior Across Cultures without Losing Yourself in the Process. Boston, MA: Harvard Business Review.
6. Shaules, J. (2015). The Intercultural Mind. Boston: Intercultural Press.
7. Sowell, T. (2019). Discrimination and Disparities. New York: Basic Books.

## IE-17 SUSTAINABILITY

Module code	IE-17
Module coordination	Prof. Dr. Robert Feicht
Course number and name	IE-30 Sustainability
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

**This module aims to provide students with a solid understanding of the principles and frameworks of sustainability in its ecological, social, and economic dimensions. Upon successful completion, students should be able to analyze sustainability challenges, apply relevant concepts and methods, and reflect on their role as agents for sustainable development.**

#### *Expertise*

- o Students understand the interrelationships of social, ecological, and economic factors and actors in the context of sustainability.
- o Students will know basic sustainability models and analysis methods.
- o Students understand topics such as social transformation, corporate responsibility, resource economics, and renewable energy technologies.
- o Students gain insights into the interconnectedness of environmental systems and human activities.

#### *Methodological Competence*

- o Students will be able to apply basic sustainability models and analysis methods.

- o Students cultivate practical skills such as conducting life cycle assessments.
- o Students will be able to analyze sustainability policies using game theory.
- o Students will be able to apply economic principles to regional development strategies.

#### *Personal Competence*

- o Students enhance their personal competence by engaging in self-directed learning and critical reflection on sustainability issues.
- o Students develop a deeper awareness of their roles as agents of change and stewards of environmental and social well-being.
- o Students foster a sense of responsibility and commitment to sustainable practices.

#### *Social Competence*

- o Students develop social competence by facilitating interactions via a online welcome meeting and online question-and-answer sessions.
- o Students have opportunities to engage with peers and instructors, exchanging perspectives on sustainability challenges.
- o Students explore collaborative approaches to address sustainability challenges.

## **Applicability in this and other Programs**

The course can be used as a basic sustainability module for all degree programmes.

## **Entrance Requirements**

Chemistry (IE-03) and Principles in Business and Economics (IE-04) are recommended.

## **Learning Content**

**1. General principles of sustainability** (Students learn about the interrelationships of social, ecological and economic factors and actors and apply basic sustainability models and analysis methods.)

- 1.1 Introduction to sustainability
- 1.2 Social transformation
- 1.3 Corporate responsibility
- 1.4 Sustainability management
- 1.5 Life cycle assessment
- 1.6 Education for sustainable development

**2. Economic framework for sustainability** (Students learn methods of environmental and resource economics and assess the use of sustainability policy)

instruments.)

- 2.1 Fundamentals of resource, environmental and public good economics
- 2.2 Sustainability policy
- 2.3 Game theory and behavioural economics in the context of sustainability
- 2.4 Economics of climate change
- 2.5 Sustainable regional development

**3. Materiality and sustainability** (Students understand the material cycles of the earth and learn about the production of materials from renewable raw materials and the recycling and disposal of products.)

- 3.1 Resource consumption and finiteness
- 3.2 Primary/secondary biomass and material cycles
- 3.3 Materials from renewable resources
- 3.4 Recycling and biorefinery concepts

**4. Energy and sustainability** (Students understand the basics of climate change. They learn about current technologies and developments and assess measures in the field of regenerative energy systems in the context of grid expansion, energy distribution and storage technologies.)

- 4.1 Introduction to energy and sustainability
- 4.2 Climate change and greenhouse effect
- 4.3 Fundamentals of selected technologies
- 4.4 Future energy systems

## Teaching Methods

This course is a CLASSIC vhb course. With the help of this internet-based teaching and learning offer, learning can take place independent of time and location. The supporting university for this course is the Deggendorf Institute of Technology, Faculty ECRI. The course is offered every semester. In addition to online self-study, a welcome meeting and two online question-and-answer sessions are offered each semester. This ensures a sufficient degree of interactivity and the opportunity for students to ask questions.

## Remarks

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## Recommended Literature

The material provided on iLearn includes numerous references for further reading.

## IE-18 BUSINESS LAW

Module code	IE-18
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Business Law
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

After completing the module, students are able to familiarize themselves with relevant topics of private law and taxation and relate these to adjacent fields like accounting or financing.

#### *Knowledge*

- o Students know and understand the basics of contract law including the links to the areas of corporate governance, economics, ethics, and financing.
- o Students know and understand the basics of commercial and corporate law and learn to anticipate relevant legal risks within the economic life.
- o Students are aware of the links between the individual fields of law and their influence on other areas of law, such as tax law and social security law.

#### *Skills*

- o Students master the handling of the legal text.
- o Students are able to identify the fundamental specifications of individual as well as company taxation for various forms of business ownership.

- o Students are proficient in dealing with income taxation and sales tax.
- o Students are able to apply the acquired knowledge at the company level and apply it strategically, to assess problems and to provide suitable solutions.

### **Personal competence**

#### *Social competence*

- o By incorporating group discussions on current developments and events both in business life and on the political level, students experience the complexity of business law and taxation aspects.
- o Students develop communication skills that are supported by tasks and case studies.
- o Students can present their analyses in a goal-oriented and application-oriented manner matching the target audience.
- o Students are able to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.

#### *Autonomy*

- o Addressing legal and tax aspects strengthens the self-confidence of the students in dealing with similar problems. In case of multiple solution options, they are able to identify a constructive solution.
- o Students can handle complex work and study contexts independently and design them in an application-oriented way.
- o Students are able to relate their acquired knowledge to other lectures and topics.

### **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of business law and taxation.

### **Entrance Requirements**

Principles in Business (IE-05) and Accounting (IE-04) are recommended.

### **Learning Content**

#### **Business law**

1. Overview of law basics
2. Legal entities and their capacity to contract
3. Legal transactions and contract law; Breach of contracts
4. Legal representation and agency
5. Objectives of form for contracts

6. Standard business terms
7. Basics of international contract law
8. Torts and product liability
9. Commercial and corporate law

### **Taxation**

1. History and origins of the tax system
2. Introduction to income tax
  - Basic terms and definitions of the income tax
  - Methods to the ascertainment of profits
  - Consideration of loss by the income tax
3. Introduction to corporate taxation
  - Determination of the taxable corporate income
  - Allowable and not allowable expense
  - Hidden profit distribution and deposits
  - Trade tax
4. Basic taxation-related circumstances of value added tax

### **Teaching Methods**

Seminaristic teaching combining lecture, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

### **Remarks**

Teaching is supported by iLearn platform: Relevant course materials are made available online.

### **Recommended Literature**

#### **Business law**

Musielak H.-J., Hau W.; "Grundkurs BGB"; München: C.H. Beck.  
 Dietl C.E., Lorenz E.; "Wörterbuch Recht, Wirtschaft & Politik = Dictionary of Legal, Commercial and Political Terms, Band/Volume 2"; München: C.H. Beck.

#### **Taxation**

Jochum H., Thiele P.J.; "Introduction to German Tax Law"; Stuttgart: Boorberg.  
 Dommermuth T., Herrler H., Hottmann J., Huber-Jahn I., Schmidt C., Weggenmann H.R.; "Ertragsteuern (Betriebliche Steuern)"; Stuttgart: Schäffer-Poeschel.  
 Zenthöfer W., Alber M.; "Körperschaftsteuer und Gewerbesteuer (Grundkurs des Steuerrechts)"; Stuttgart: Schäffer-Poeschel.  
 Woywode U.; "Wörterbuch Rechnungslegung und Steuern. Accounting and Tax Dictionary"; Willingshausen: e-Lex.

## IE-19 FOREIGN LANGUAGE III

Module code	IE-19
Module coordination	Tanja Mertadana
Course number and name	Foreign Language III
Lecturer	Dozierende für AWP und Sprachen
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	4
Workload	Time of attendance: 60 hours self-study: 60 hours Total: 120 hours
Type of Examination	See examination schedule AWP and languages, written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	4/210
Language of Instruction	English

### Module Objective

The module Foreign Language III aims to equip students with specialised language skills necessary for qualified professional activity in a globalised field of Industrial Engineering. It aims to deepen and refine the students understanding of the respective language in scientific and technical fields in order to enable them to use the language effectively and efficiently as a practical means of communication.

The module covers the four basic language skills - listening, reading, speaking and writing. Students expand their subject-specific vocabulary and deepen their knowledge of the language structures.

The main focus of the module is to optimise fluency and improve the ability to communicate in the respective language in order to clearly understand and explain complex texts and conversations in professional context. Through task-based speaking, listening, reading and writing activities, students optimise their communicative skills and develop their ability to express themselves. This enables them to participate in expert discussions, work in a team, prepare relevant documents independently and in a competent manner and to give successful presentations in the respective language.

For international students without completed and certified German B2 proficiency Foreign Language III means German as a Foreign Language.  
For students at German level C1 (completed and certified German B2) Foreign Language III means an English course that is an integral part of the curriculum.

### **Communication Skills in a Technical Context, C1:**

On completion of the module, the students will have achieved the following learning objectives:

#### Subject-specific skills

At Level English C1, students should be able to:

- o have a strong level of English (C1, CEFR) and be able to understand and take part confidently in expert discussions and negotiations in the field of Industrial Engineering.
- o They will have the skills to understand and analyse specialised literature and to write texts at C1 level.
- o Students will have acquired the skills to express themselves at C1 level in professional contexts.
- o They will understand increasingly complex topics in their area of specialisation and can discuss them in a spontaneous and flexible manner.
- o They will develop the ability to apply grammatical structures both in a functional and targeted manner in their future professional fields.
- o They will be able to deliver clear and detailed presentations on relevant topics related to Industrial Engineering and give comprehensive answers to relevant questions.
- o They will be able to express personal opinions and different points of view, including a consideration of the pros and cons, effectively and spontaneously.

#### Methodological skills

Methodological skills refer to the students' ability to use a variety of learning and working methods to further develop their linguistic and subject-specific knowledge

- o Students will expand their language acquisition skills by reflecting on their individual styles of learning.
- o They will be able to filter information from different English sources and use it for discussions and presentations.

- o They will be able to participate actively and self-assertive in subject-specific discussions and debates concerning Industrial Engineering by presenting arguments and giving constructive feedback.
- o Critical reflection on their own learning progress and strategies.

#### Social skills

Social skills refer to students' ability to conduct themselves appropriately, communicating effectively and working in groups when engaging in social interactions.

- o Students will have developed their social skills of teamwork, reliability, and negotiation skills.
- o They will have the communication skills necessary to collaborate with others to find solutions.
- o They will reflect on their learning experiences from independent projects and teamwork.
- o They are empathic and able to understand other viewpoints and opinions and to respond appropriately to these.
- o They acquire the ability to resolve conflicts constructively and to liaise between deviating viewpoints.

#### Personal skills

Personal skills refer to students' individual abilities, attitudes and traits that enable them to achieve their goals, further their personal development and work successfully.

- o Students will have developed sound language skills and social skills, which are of fundamental importance for personal development and the future work environment.
- o Development of problem-solving skills and the ability to explain solutions fluently in English.

#### **German as a Foreign Language:**

The learning objectives can be found in the corresponding course description on the homepage of the Language Centre:

<https://www.th-deg.de/en/students/language-electives#german>

### **Applicability in this and other Programs**

Applicable in other degree programmes: ESE-3, HI-3

### **Entrance Requirements**

### **Communication Skills in a Technical Context, C1:**

The prerequisite for successful participation in the module is a command of the English language at B2 level, based on the Common European Framework of Reference for Languages (CEFR).

### **German as a Foreign Language:**

For advanced language courses, students have to prove the required language skills (for example through successful completion of a lower level, certificates, placement test).

## **Learning Content**

### **Communication Skills in a Technical Context, C1:**

- o Describing technical topics to non-experts
- o Maths, numbers and statistics
- o Big Data
- o Good and Bad Design
- o Invention and Innovation
- o Describing forces
- o Materials and their properties
- o Energy Systems
- o Sustainability
- o Computer Hardware and Systems
- o Chat GPT
- o AI and the Singularity
- o Robotics

The key language items to be covered include (though are not restricted to):

- o The active and passive voice
- o Advanced work on the past tense

- o Using analogies, similes and metaphors to describe technology

### **German as a Foreign Language:**

The course content can be found in the corresponding course description on the homepage of the Language Centre:

<https://www.th-deg.de/en/students/language-electives#german>

## **Teaching Methods**

The teaching methods applied will focus on optimising the four main language skills (listening, speaking, reading and writing). Examples of the applied learning methods include various forms of group, individual and collaborative work, mini-presentations, exercises involving intensive reading and listening, role plays and grammar games, loci method, dictation exercises, translations, peer feedback, working with learning stations, and various writing activities designed to consolidate the content learnt.

Students will be given weekly assignments for self-study.

## **Remarks**

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

## **Recommended Literature**

### **Communication Skills in a Technical Context, C1:**

Bauer, Hans-Jürgen. *English for Technical Purposes*. Berlin: Cornelson, 2000.

Blockley, David. *Engineering: A Very Short Introduction*. Oxford: OUP, 2012.

Emmerson, P. *Business Vocabulary Builder*. London: Macmillian, 2009.

Foley, Mark, and Diane Hall. *MyGrammarLab*. Harlow: Pearson, 2012.

Glendinning, Eric H., and Alison Pohl. *Technology 2*. Oxford: Oxford UP, 2008.

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

Munroe, Randall. *Thing Explainer: Complicated Stuff in Simple Words*: John Murry, 2017.

Puderbach, Ulrike, and Michael Giesa. *Technical English - Mechanical Engineering*. Haan-Gruiten: Verl. Europa-Lehrmittel Nourney, Vollmer, 2012.

### **German as a Foreign Language:**



Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:

<https://www.th-deg.de/en/students/language-electives#german>

## IE-20 FINANCING

Module code	IE-20
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Financing
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

**This module aims to provide students with a solid knowledge and a deep understanding of the most important concepts and instruments of investment and financing. The high practical relevance is ensured by working on exercises using MS Excel, enabling students to solve relevant business problems and make well-founded financial decisions.**

#### *Expertise*

- o Students will know and understand central methodological foundations and instruments of investment and financing.
- o Students have deep knowledge about asset pricing concepts in capital markets.
- o Students are familiar with the fundamental differentiation between equity and debt and understand how different capital structures affect a company's income and risk.

#### *Methodological Competence*

- o Students are able to differentiate corporate finance from other business functions in terms of its contents and its conceptual framework.

- o Students can classify the functions of investment and financing into the operational sequences.
- o Students are able to independently find adequate solutions for problem situations that require investment and financing solutions.

#### *Personal Competence*

- o Students can independently choose and employ suitable valuation approaches for the respective task.
- o Students understand the limitations, assumptions and problems of methods and instruments of investment and financing in a specific context.
- o Students are able to relate their acquired knowledge to other lectures and topics.

#### *Social Competence*

- o Students can appropriately communicate their solutions of investment and financing problems to the team or other professionals, i.e. they gain target group appropriate communication skills.
- o Students' discussion skills in the academic context are strengthened through the interactive character of the lectures and tutorials.

## **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of investment and financing decisions.

## **Entrance Requirements**

Principles in Business (IE-05), Accounting (IE-04), Business Law (IE-10), and Applied Mathematics (IE-14) are recommended.

## **Learning Content**

1. Overview of financial management
2. Understanding financial statements and cash flow
3. Time value of money
4. Valuing stocks and bonds
5. Risk and the required rate of return
6. Capital Budgeting

## **Teaching Methods**

Seminaristic teaching combining topic-oriented lectures, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate

didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

The seminar is accompanied by tutorials where calculation examples from the course are repeated for better understanding and examples similar to those used during course sessions are calculated.

## Remarks

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## Recommended Literature

### Basic literature

Ross S.A., Westerfield R.W., Jordan B.D.; "Essentials of Corporate Finance"; New York: McGraw-Hill Education.

Gitman L.J., Zutter C.J.; "Principles of Managerial Finance"; Harlow: Pearson Education.

Brealey R.A., Myers S.C., Allen F.; "Principles of Corporate Finance"; New York: McGraw-Hill Education.

### Supplementary literature

Berk J., DeMarzo P.; "Corporate Finance: The Core"; Harlow: Pearson Education.

Brigham E.F., Houston J.F.; "Fundamentals of Financial Management"; Boston, MA: Cengage Learning.

Keown A.J., Martin J.D., Petty J.W.; "Foundations of Finance"; Harlow: Pearson Education.

## IE-21 LOGISTICS AND OPERATIONS RESEARCH

Module code	IE-21
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Logistics and Operations Research
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	
Language of Instruction	English

### Module Objective

**This module aims to provide students with a solid understanding of the core concepts and requirements of operational management as well as the operational functions in procurement, production, distribution, and logistics within the context of Supply Chain Management (SCM). Within this module, the practical application of quantitative methods for solving problems in the field of logistics, SCM, and Operations Research is enabled through the use of suitable optimization software.**

#### *Expertise*

- o Students understand the core concepts and requirements of operational management and the operational functions of procurement, production, distribution, and logistics affected by supply chain management (SCM).
- o Students are familiar with the concepts of integrative logistics and SCM as optimizing cross-departmental functions and practice process-oriented thinking.
- o Students understand the fundamental problems in the functional areas of a company considering adequate SCM-design requirements (e.g., determination of demand, ordering and inventory policies, short and long-term production planning).

- o Students will know core concepts of linear optimization and graph theory.

#### *Methodological Competence*

- o Students are qualified to build up comprehensive and detailed mathematical models with a focus on linear optimization and graph theory.
- o Students are able to analyze fundamental problems in the functional areas of a company and solve them using powerful methods.
- o Students can apply the acquired knowledge of Operations Research unerringly to problems in the field of logistics, estimate the complexity, and choose and apply appropriate solution methods.
- o Students are able to model a linear programming problem using spreadsheet software packages and their implemented Solver add-ins.

#### *Personal Competence*

- o Students can analyze decision-making processes in companies on their own and in a structured manner, by applying appropriate modeling and problem-solving methods. They are equally familiar with quantitative and qualitative issues.
- o Students can assess the approaches' plausibility under different conditions, knowing the advantages and disadvantages of individual methods.
- o Students are able to relate their acquired knowledge to other lectures and topics.

#### *Social Competence*

- o In group work, students master SCM-relevant tasks, which require the handling of conflicting goals of the company and the development of convincing argumentation.
- o Close cooperation deepens students' social competences and fosters a team-oriented working style.
- o The interactive character of the lectures and tutorials strengthens the students' discussion skills in the academic context.

## **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of logistics and quantitative decision support systems.

## **Entrance Requirements**

Principles in Business (IE-05), Analytical Principles of Engineering (IE-01), Mathematics for Engineering (IE-07), and Applied Mathematics (IE-14) are recommended.

## Learning Content

### Logistics

1. Introduction to operations management
2. Competitiveness, strategy, and productivity
3. Forecasting
4. Product and service design
5. Strategic capacity planning
6. Process selection and facility layout
7. Work design and measurement
8. Location planning and analysis
9. Inventory management
10. JIT and lean operations
11. Supply chain management

### Operations Research

1. Introduction
2. Linear programming
  - Introduction
  - Sensitivity analysis
  - Applications
3. Distribution and network models
4. Integer linear programming

## Teaching Methods

Seminaristic teaching combining topic-oriented lectures, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

The seminar is accompanied by tutorials where calculation examples from the course are repeated for better understanding and examples similar to those used during course sessions are calculated.

## Remarks

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## Recommended Literature

### **Logistics**

Stevenson W.J.; "Operations Management"; New York: McGraw-Hill Education.  
Jacobs F.R., Chase R.B.; "Operations and Supply Chain Management"; New York: McGraw-Hill Education.  
Coyle J.J., Langley C.J., Novack R.A., Gibson B.J.; "Supply Chain Management. A Logistics Perspective"; Boston, MA: Cengage Learning.  
Chopra S.; "Supply Chain Management. Strategy, Planning, and Operation"; Harlow: Pearson Education.

### **Operations Research**

Anderson D.R., Sweeney D.J., Williams T.A., Camm J.D., Cochran J.J.; "An Introduction to Management Science"; Boston, MA: Cengage Learning.  
Ragsdale C.T.; "Spreadsheet Modeling and Decision Analysis"; Boston, MA: Cengage Learning.  
Taylor B.W.; "Introduction to Management Science"; Harlow: Pearson Education.  
Lawrence J.A., Pasternack B.A.; "Applied Management Science. Modeling, Spreadsheet Analysis, and Communication for Decision Making"; New York: Wiley.

## IE-22 TECHNICAL MECHANICS II

Module code	IE-22
Module coordination	Prof. Markus Hainthaler
Course number and name	Technical Mechanics II
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Qualification Goals

Within this course, students acquire the ability to understand the relationship between the correct choice of materials, their behaviour under mechanical stresses (including failure) and their applicability for the design of real machines. Additionally, they are able to sketch their design ideas with the most common types of technical drawings. This creates the basis for any further subject within the study programme where reliable design of plant equipment is crucial.

#### Professional and methodological Competences

##### *Knowledge*

From IE-10 Technical Mechanics I, the students are already capable of analysing the distribution of forces and moments acting on simplified mechanical structures. Within this module, these competences are developed further towards the design of realistic machine components, beginning with the choice of the adequate construction material up to the evaluation of the component's probability to fail. All these steps of construction are practiced with idealized geometric parts. Altogether, this expertise will be needed in all further engineering lectures of the study programme which include the design and operation of apparatuses and other plant equipment.

### *Skills*

After completing this module, the students will be able to discuss with design specialists about problem-solving in all steps of construction. They understand the advantages and disadvantages of applying the most common construction materials, and the calculation procedure of analysing and evaluating combined stresses on machine parts and their safety against failure. Additionally, they possess a general understanding how to generate and interpret both 2D and 3D technical drawings.

### **Personal and social Competences**

The solution of the tasks given both in the lecture and the exam requires students' self-responsible and self-directed working style. Herein, the concepts of all module topics have to be applied to new problems, analyzed regarding their relevance, and evaluated in order to yield a reliable result. Each student has practiced step by step how to create 3D objects both as a technical drawing and a machineable plant component.

### **Applicability in this Program**

IE-29 Plant Engineering

IE-Elective Process Engineering

IE-Elective Process Optimization

### **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programmes that deal with materials selection and the design of plant and construction equipment.

### **Entrance Requirements**

Successful completion of the following modules is recommended:

Analytical Principles of Engineering (IE-01), Mathematics for Engineering (IE-08), Technical Mechanics I (IE-10), Physics (IE-11)

### **Learning Content**

#### **Material Science**

- o General material properties: classification, applications and selection criteria, chemical bonding in solids, phase diagrams
- o Mechanical properties fundamentals: stress and strain, Hooke's law, strength, hardness

- o Metals: steel, light alloys, copper alloys; processing, properties and applications
- o Ceramics: processing, properties and applications of oxides, nitride and carbides
- o Glass: structure, processing, properties and applications of silicate glasses
- o Polymers: structure, properties and applications
- o Composite materials: structure, processing, properties and applications

### **Technical Drawing**

- o National and international standards of technical drawings
- o Isometric projection: normal objects, box construction, non-isometric and curved shapes
- o Geometric construction: angles, parallels, tangents, circles, arcs, bisections, geometric objects, complex objects
- o Orthographic projection: generation of views, missing view problems, normal and inclined faces, curved faces

### **Machine Component Design**

- o Elastic / plastic deformation
- o Static body stresses: description of single stresses, Mohr circle representation, combination of stresses, analytical and graphical evaluation
- o Failure Analysis: Safety factors, failure theories, graphical representation
- o Threaded fasteners: characterization, stresses and loads, initial tensile force, tightening torque
- o Bearings & lubrication: stresses and loads, types of friction, types of lubricants, Stribeck curve

### **Teaching Methods**

The lecture focuses on seminaristic teaching, but also applies detailed practical exercises based on the theoretical background. The key content is denoted in a written script via visualizer, while the supplemental content is conveyed via slide and video presentations. All material is uploaded to an online learning portal (iLearn). The students are strongly invited to discuss real-life problems and applications interactively throughout the lecture. Concerning technical drawing, each student is engaged to join the construction procedure, and the drawings are developed step by step with individual help. Tutorials will be offered on demand.

### **Remarks**



A drawing set consisting of at least a set square, compasses, a thin and a thick pen and an eraser is essential for each student.

## **Recommended Literature**

- o W.D. Callister, D.G. Rethwisch "Materials Science and Engineering - An Introduction", Wiley, 9th edition 2013
- o F.E. Giesecke, A. Mitchell et al. "Technical drawing with engineering graphics", Pearson, 15th edition 2016
- o R.C. Juvinall, K.M. Marshek "Machine Component Design", Wiley, 5th edition 2012

## IE-23 ENERGY TECHNOLOGY

Module code	IE-23
Module coordination	Prof. Dr. Rui Li
Course number and name	Energy Technology
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

Energy is an important topic for engineering students. The students should understand and apply the basic principles of thermodynamics and applications for conventional energy technology.

#### Professional competences:

The students know the transport phenomenon in the engineering systems, and they could be able to apply thermodynamics laws to make analysis for different power cycles. By presenting a wealth of real-world engineering examples in this lecture, students are given a feel for how thermodynamics is applied in engineering practice. The students are able to develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments.

#### *Knowledge*

Students are able to explain and reproduce the following basic theories, principles and practical applications:

- o Physical concepts related to thermodynamics
- o First law of thermodynamics for the energy conservation
- o Properties of pure substances namely water and air, e.g. what is phase change

- o Energy balance analysis of closed and open systems e.g. turbine, compressor
- o Second law thermodynamics and increase of entropy principle
- o How a steam or gas power station works
- o How an automobile engine works
- o Entropy and exergy analysis for power systems

#### *Skills*

- o Communication skill directly to the minds of the engineers in a simple yet precise manner
- o Ability to solve the thermal related problem with properties of substances and laws of thermodynamics
- o Ability to have creative thinking and development of a deeper understanding and intuitive feel for thermodynamics

#### **Methodological competence:**

The students present and classify open system and close system thus apply different approaches to solve the problem. They are familiar with different working fluids thus apply corresponding approaches to do the correct calculations. They are capable of analysing conventional steam or gas power plants, and car engines.

#### **Social / personal competence:**

The students are able to

- o express their arguments in a comprehensible way within a group in the field of energy technology.
- o reflect their knowledge, evaluate their own results and sustainable ideas

### **Applicability in this and other Programs**

W-16 Fluid- und Energietechnik, BA Wirtschaftsingenieurwesen at THD

D-4108 Technische Thermodynamik, BA Maschinenbau at THD

100-790 Thermodynamics, BA General Engineering at THD

And any other study programme that deals with thermodynamics.

### **Entrance Requirements**

Analytical principles of engineering (IE-01)

Mathematics for engineers (IE-07)

Physics (IE-11)

## Learning Content

- o Energy, energy transfer and energy analysis
- o Properties of pure substances: enthalpy, latent heat, specific heat, steam table, equation of state, ideal gas
- o Closed system and open system (control volume)
- o Second law of thermodynamics, Carnot cycle, entropy, isentropic process
- o Rankine cycle, Brayton cycle, Otto cycles, Diesel cycle
- o Exergy, exergy analysis
- o Components: boiler, chiller, steam turbine, gas turbine, cooling tower, etc.
- o Advanced power generations: combined steam-gas power plants, cogeneration, super critical power plants, etc.

## Teaching Methods

Seminaristic teaching / exercises / tutorials / trial exam

The presentation slides are available in the online platform ilearn, and all important contents will be repeatedly emphasized by script via a visualizer. Additional tutorials are offered bio-weekly with concrete problem solution process.

## Recommended Literature

- o Çengel Y. A., Boles M.A.: Thermodynamics: An Engineering Approach, 8<sup>th</sup> Edition, McGraw-Hill Education, New York, 2014
- o Demirel Y.: Energy: Production, Conversion, Storage, Conservation, and Coupling, 2<sup>nd</sup> Edition, Springer-Verlag, London, 2016
- o Langeheinecke K., Jany P., Thieleke G, Langeheinecke K., Kaufmann A.: Thermodynamik für Ingenieure, 9. überarb. u. erweiterte Auflage, Springer Vieweg, 2013

## IE-24 FUNDAMENTALS OF MEASUREMENT AND CONTROL ENGINEERING

Module code	IE-24
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Fundamentals of Measurement and Control Engineering
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

Students are able to explain and reproduce basic theories, principles, and methods related to:

- o Fundamentals of measuring physical quantities
- o Measuring methods, devices and instruments
- o Measurement of electrical and non-electrical quantities
- o Analysis and processing of measurement results
- o Basic control systems as well as control engineering relationships
- o Mathematical modelling of control systems
- o Control systems analysis and design using various different methods

- o Dynamic system behaviour in time and frequency domain, and can explain properties of first and second order systems
- o Dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus
- o Nyquist stability criterion and the stability margins derived from it
- o Role of the phase margin in analysis and synthesis of control loops

### **Skills**

Students are capable of:

- o Measurement and analysis of various physical signals and quantities
- o Employing basic measurement instruments
- o Evaluating problems of metrology and to apply methods for describing and processing of measurements
- o Employing software tools for measurement, data analysis and processing
- o Characterisation of controlled systems based on their static and dynamic responses
- o Analysing using time and frequency response techniques
- o Analysing absolute and relative stability of control systems
- o Design and synthesising closed-loop controllers
- o Using software tools (Matlab, Octave, etc.) for carrying out control system analysis

### **Personal competence**

#### **Social competence**

Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs.

#### **Autonomy**

- o The students can reflect their knowledge and discuss and evaluate their own results
- o Applying of theoretical concepts to practical applications

### **Applicability in this and other Programs**

The module provides the background competences for the Applied Measurement and Control Engineering module (IE-27) and for all other modules and study programs that require the fundamentals in the measurement and control fields.

## Entrance Requirements

Fundamentals of Electrical Engineering (IE-15), Physics (IE-11), Technical Mechanics I (IE-03) & Technical Mechanics II (IE-09) are recommended.

## Learning Content

The module provides introduction to fundamentals of measurement and control engineering focusing on:

- o Measurement parameters, unit systems, standards
- o Signals, characterisation, conversion
- o Measuring methods and devices, basic instruments
- o Evaluation of measurement results, errors and uncertainties
- o Measurement of electrical quantities
- o Measurement of non-electrical physical quantities
- o Analog and digital procedures
- o Reliability measurements
- o Introduction to control systems
- o Mathematical modelling of control systems
- o Modelling of mechanical, electrical, fluid and thermal systems
- o Transient and steady-state response analyses
- o Control systems analysis and design, root-Locus method
- o Frequency-response methods
- o PID controllers and modified PID controllers
- o Control systems analysis and design in state space

## Teaching Methods

Lectures / exercises / tutorials / home work

PowerPoint presentation, whiteboard, document camera (visualiser) and additional lecture materials in iLearn

## **Recommended Literature**

- o Messtechnik: Grundlagen und Anwendungen der elektrischen Messtechnik, Ausgabe 8, Parthier R., Springer 2016
- o Modern Measurements: Fundamentals and Applications, A. Ferrero, D. Petri, P. Carbone, M. Catelani, Wiley 2015
- o Electrical Measurements in the Laboratory Practice, Bartiromo R., De Vincenzi M., Springer 2016
- o Modern Control Engineering, 5th Edition, Katsuhiko Ogata, Pearson 2010
- o Modern Control Systems, 13th Edition, Richard C. Dorf, Robert H. Bishop, Pearson 2017
- o The Control Handbook, 2nd Edition (3 volume set: Control System Fundamentals; Control System Applications; Control System Advanced Methods), William S. Levine, CRC Press 2010

## IE-25 FOREIGN LANGUAGE IV

Module code	IE-25
Module coordination	Tanja Mertadana
Course number and name	Foreign Language IV
Lecturer	Dozierende für AWP und Sprachen
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	2
ECTS	2
Workload	Time of attendance: 30 hours self-study: 30 hours Total: 60 hours
Type of Examination	See examination schedule AWP and languages, written ex. 60 min.
Duration of Examination	60 min.
Weighting of the grade	2/210
Language of Instruction	English

### Module Objective

The module Foreign Language IV aims to equip students with specialized language skills necessary for independent performance in a globalized Industrial Engineering sector. In doing so, it strives to deepen students' relationship with the respective language so that they can effectively and efficiently implement the language as a practical communication tool.

The module covers the four basic language skills - listening, reading, speaking and writing. Students expand their subject-specific vocabulary and deepen their knowledge of the language structures.

The main focus of the module is to optimise fluency and improve the ability to communicate in the respective language in order to clearly understand and explain complex texts and conversations in professional context. Through task-based speaking, listening, reading and writing activities, students optimise their communicative skills and develop their ability to express themselves. This enables them to participate in expert discussions, work in a team, prepare relevant documents independently and in a competent manner and to give successful presentations in the respective language.

For international students without completed and certified German B2 proficiency Foreign Language IV means German as a Foreign Language.

Students at German level C1 (completed and certified German B2) can choose between different languages available for selection. The course offer varies each semester.

The learning objectives can be found in the corresponding course description on the homepage of the Language Centre:

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://www.th-deg.de/en/students/language-electives#languages>

## **Applicability in this and other Programs**

Applicable in other degree programmes.

## **Entrance Requirements**

For advanced language courses, students have to prove the required language skills (for example through successful completion of a lower level, certificates, placement test).

## **Learning Content**

The course content can be found in the corresponding course description on the homepage of the Language Centre:

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://www.th-deg.de/en/students/language-electives#languages>

## **Teaching Methods**

The teaching methods applied will focus on optimising the four main language skills (listening, speaking, reading and writing). Examples of the applied learning methods include various forms of group, individual and collaborative work, mini-presentations, exercises involving intensive reading and listening, role plays and grammar games, loci method, dictation exercises, translations, peer feedback, working with learning stations, and various writing activities designed to consolidate the content learnt.

Students will be given weekly assignments for self-study.

## **Remarks**

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

## **Recommended Literature**

Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://www.th-deg.de/en/students/language-electives#languages>

## IE-26 COMPULSORY ELECTIVE SUBJECT OF A GENERAL ACADEMIC NATURE (AWP) II

Module code	IE-26
Module coordination	Tanja Mertadana
Course number and name	AWP II
Lecturer	Dozierende für AWP und Sprachen
Semester	4
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	2
ECTS	2
Workload	Time of attendance: 30 hours self-study: 30 hours Total: 60 hours
Type of Examination	See examination schedule AWP and languages
Weighting of the grade	2/210
Language of Instruction	English

### Module Objective

This AWP (compulsory elective subject of a general academic nature) elective module enables students to acquire knowledge and skills in subject areas beyond the scope of their chosen degree programme.

Students can choose both face-to-face courses and courses offered by the Virtuelle Hochschule Bayern (VHB). Students acquire knowledge and skills in the following areas:

- o in a foreign language (language skills)
- o in the didactic-pedagogical area (methodological skills)
- o in the social sciences (social skills)
- o in the psychological-sociological field (social skills)
- o in the technical and scientific field (professional skills)
- o in the philosophical-social-ethical area (personal skills)

Students at German level C1 (completed and certified German B2) are free to choose their courses from the list of elective (AWP) courses offered to expand their knowledge according to their own preferences.

For international students without completed and certified German B2 proficiency AWP II means German as a Foreign Language.

## **Applicability in this and other Programs**

Applicable in other degree programmes.

## **Entrance Requirements**

Elective (AWP) courses: Elective (AWP) courses may not have any overlapping content with the student's current degree programme.

German as a Foreign Language + Other languages: For advanced language courses, students have to prove the required language skills (for example through successful completion of a lower level, certificates, placement test).

## **Learning Content**

The course content can be found in the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

## **Teaching Methods**

The teaching and learning methods can be found in the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

## **Remarks**

For course-specific details, please refer to the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

electives#german

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

All language courses require a compulsory attendance rate of 75% in order to be allowed to take the examination.

## **Recommended Literature**

Recommended reading can be found in the corresponding course description on the homepage of the Language Centre:

Elective (AWP) courses: <https://www.th-deg.de/en/students/language-electives#electives>

German as a Foreign Language: <https://www.th-deg.de/en/students/language-electives#german>

Other languages: <https://th-deg.de/language-and-electives-centre#languages>

## IE-27 PROCESS SAFETY

Module code	IE-27
Module coordination	Prof. Dr. Rui Li
Course number and name	IE-28 Process Safety
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

The students understand the importance of process reliability, its key concepts and practical approaches needed to avoid potentially catastrophic incidents and to improve the efforts in managing process hazards. Upon completion of this module the students should have the following competences:

#### Professional competence

##### *Knowledge*

- o Students understand and explain why and how these process safety systems have been implemented in some certain way, what they are intended to achieve, how to apply them daily to achieve safe and reliable operations, and possibly, how to improve them as needed.
- o Students should know three essential parts of a process safety system that focus on general concepts of "safety culture".
- o They know safety pyramid with different levels and the way to define process risk. They are able to carry out a risk assessment considering the frequency and consequence.

- o The students should identify different pictograms with specific hazard information. Students understand and explain typical barrier protection layer models.
- o Operational disciplines should be well understood from both the organizational and personal point of view.
- o The students are familiar with personal protective equipment and hazardous materials, as well as the fire explosion.

#### *Skill*

- o Ability to apply key concepts and methodologies to support effective process safety systems.
- o Ability to transfer the knowledge to fill in potential gaps between the approaches presented in this course and the practices in facility.
- o Ability to analyze the facility's process safety program.

#### **Method competence:**

After participating in this module, students will be able to understand safety culture and obey the safe guidelines in any working place. Based on the basic fundamental aspects of safety methodology, they can also meet and overcome the challenges that the safety is needed to be further updated as the technology develops, e.g. further maintaining/improving the facility's process safety program.

#### **Personal and social competence:**

- o Students should be able to let themselves complete work safely everyday.
- o They have the personal communication skills to find the potential hazard not only from themselves but also from the coworkers, thus prevent the incidents in the first place.
- o They reflect their disciplines to use safely the hazardous materials and process.

### **Applicability in this and other Programs**

BA Wirtschaftsingenieurwesen at THD

The learning outcomes of this module can be applied in any lectures and other study programmes that deal with process reliability, work safety, and hazard protection.

### **Entrance Requirements**

Physics (IE-11)

### **Learning Content**

- o Introduction to Process Safety and its importance

- o Safety Culture, Safety Permit Systems
- o Process Safety Systems, Process Risk Assessment
- o Protection Layer Model (Swiss Cheese Model, Bow Tie Diagrams)
- o Operational Discipline (Organizational and Personal OD)
- o Personal Protective Equipment
- o Gases, Vapors, Particulates, Toxic Metals, Hazards of Liquids
- o Hazardous Chemical Identification
- o Fire and Explosion

## **Teaching Methods**

seminaristic teaching / exercises / case study / home work

## **Recommended Literature**

James A. Klein, Bruce K.: Process Safety: Key Concepts and Practical Approaches. CRC Press Taylor & Francis Group, 2017.

Charles E. Thomas Process Technology: Safety, Health, and Environment. Cengage Learning, 3rd Edition, 2011

Kahl A., Bier M.: Arbeitssicherheit: Fachliche Grundlagen, Erich Schmidt Verlag, 2019

## IE-28 APPLIED MEASUREMENT AND CONTROL ENGINEERING

Module code	IE-28
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Applied Measurement and Control Engineering
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

Students are able to explain and reproduce basic theories, principles, and methods related to:

- o Measuring devices and instruments
- o Principles for measuring electrical and non-electrical quantities
- o Data analysis and processing methods, linearization of characteristics
- o Action principles of open- and closed-loop control technologies
- o Industrial discontinuous controllers with two and three-level outputs
- o Industrial continuous signal controllers

##### Skills

Students are capable of:

- o Employing measurement instruments

- o Implementing various measurement circuits
- o Employing software tools for measurement data acquisition, data analysis and processing
- o Recording characteristics and of dynamic responses
- o Recording characteristics and applying mathematical corrections
- o Characterisation of controlled systems based on their static and dynamic responses
- o Assessing of responses to set-point changes and disturbance variables of control systems
- o Applying time and frequency response methods for the analysis of control systems
- o Using software tools (Matlab, Octave, etc.) for carrying out control system analysis
- o Design and implementation of closed-loop controllers
- o Plan and structure practical work and evaluate work in progress
- o Analyse data by applying different methods and critically evaluate and interpret the results
- o Document experimental work and results, present and discuss them

### **Personal competence**

### **Social competence**

The students will be able to:

- o Work in small groups to jointly solve technical problems, and experimentally validate their measurement and controller designs
- o Compare theoretical results with experiments and discuss it within the group
- o Present and defend the results of their work

### **Autonomy**

The students can:

- o Reflect their knowledge and discuss and evaluate their own results
- o Individually apply theoretical concepts to practical applications

## **Applicability in this and other Programs**

The module provides main competences for other courses of different study programs that require measurement and control engineering fundamentals.

## Entrance Requirements

Fundamentals of Measurement and Control Engineering (IE-26), Fundamentals of Electrical Engineering (IE-15) and Plant Engineering (IE-23) are recommended.

## Learning Content

- o Analog and digital measurements
- o Recording characteristics, dynamic response, linearization
- o Measurements of electrical parameters such as current, voltage, apparent, reactive and active power
- o Measuring frequency
- o Temperature measurement
- o Pressure measurement
- o Force and torque measurement
- o Analysis of measurement results, statistics, fitting
- o Principles of open- and closed-loop control technology
- o Characterisation of controlled systems based their static and dynamic responses
- o Control loops with discontinuous controllers
- o Design and operation of a PID controller and its sub-classes
- o Structure of the closed control loop, assessment of responses to set-point changes and disturbance variables
- o Practical exercises and applications in:
  - o automatic temperature control
  - o closed-loop speed control of an electrical drive
  - o closed-loop control of illumination intensity in a room
  - o automatic liquid level and flow rate control
  - o programmable logic control systems

Practical laboratory experimental sessions are enabling the students to consolidate the theoretical knowledge as well as to develop practical skills in addressing and handling control systems and measurement instruments.

## Teaching Methods

Seminaristic teaching / exercises / home work

Whiteboard, PowerPoint presentation, document camera (visualiser) and additional lecture materials in iLearn

Experiments in small groups using training material that relays on professional computer-based experimentation system where multimedia combines cognitive and hands-on training units into a comprehensive unified concept enabling students to consolidate theoretical building blocks and practical skills for a maximum learning effectiveness.

## Recommended Literature

- o Messtechnik: Grundlagen und Anwendungen der elektrischen Messtechnik, Ausgabe 8, Parthier R., Springer 2016
- o Modern Measurements: Fundamentals and Applications, A. Ferrero, D. Petri, P. Carbone, M. Catelani, Wiley 2015
- o Electrical Measurements in the Laboratory Practice, Bartiromo R., De Vincenzi M., Springer 2016
- o Modern Control Engineering, 5th Edition, Katsuhiko Ogata, Pearson 2010
- o Modern Control Systems, 13th Edition, Richard C. Dorf, Robert H. Bishop, Pearson 2017
- o The Control Handbook, 2nd Edition (3 volume set: Control System Fundamentals; Control System Applications; Control System Advanced Methods), William S. Levine, CRC Press 2010
- o Computer-based training material and experimentation systems on Measurement Technology and Control Technics, UniTrain Course and Systems, Lucas-Nülle - <https://www.lucas-nuelle.com/>

## IE-29 PLANT ENGINEERING

Module code	IE-29
Module coordination	Prof. Markus Hainthaler
Course number and name	Plant Engineering
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Qualification Goals

Within this course, students acquire the ability to understand the technological design and operation of plants from the equipment installed, over the plant's specific energy demands and energy transfer, up to their optimization. Additionally, they are able to sketch and discuss their design ideas with other specialists by help of the most common types of flowsheets. This creates the basis for the reliable design and operation of any plant the students are concerned in their future engineer's life.

#### Professional and methodological Competences

##### *Knowledge*

From previous semesters, the students have already been taught the fundamentals of natural sciences, engineering and economics in individual lectures. Within this module, all these separate competences are combined in order to design, operate and optimize whole plants and production systems. Its content commences with the mathematical description of fluid flows and heat transfer mechanisms between the single units of the plant, continues with modes of operation and detailed visualization of the production process, and finishes with the most important aspects of selecting the appropriate plant equipment. All these topics are practiced with real-life problems in a broad variety of production systems and applications.

### *Skills*

After completing this module, the students will be able to understand, analyse and evaluate plants and production systems regarding their actual set-up, their actual productivity, and their possible future optimization in these concerns. They can identify weaknesses of construction, layout and assembly in order to advise specialists to improve the function and efficiency of the plant. Additionally, they are able to communicate and visualize the production systems by creating flow-sheets in different depth of detailedness.

### **Personal and social Competences**

The solution of the tasks given both in the lecture and the exam requires students' self-responsible and self-directed working style. Herein, the concepts of all module topics have to be applied to new problems, analyzed regarding their relevance, and evaluated in order to yield a reliable result.

### **Applicability in this Program**

IE-37 Bachelor Module

IE-Elective Process Engineering

IE-Elective Process Optimization

IE-Elective Industrial Automation and Information Technology

IE-Elective Energy and Resource Efficiency

### **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programmes that deal with the visualization, design, operation, maintenance and optimization of plants and production systems.

### **Entrance Requirements**

Successful completion of the following modules is recommended:

Analytical Principles of Engineering (IE-01), Mathematics for Engineering (IE-08), Chemistry (IE-03), Physics (IE-11), Technical Mechanics I (IE-10) and II (IE-22), Energy Technology (IE-23), Fundamentals of Electrical Engineering (IE-15), Fundamentals of Measurement and Control Engineering (IE-24)

### **Learning Content**

#### **Fluid Mechanics**

- o Fluid characterization: classes of fluids, rheology, pressure

- o Fluid statics: submerged surfaces, buoyancy
- o Fluid kinematics (introduction): Lagrangian vs. Eulerian model, material derivative, flow visualization, unsteady flow
- o Conservation of material / energy: continuity equation, Bernoulli equation
- o Internal / external flow: velocity profiles, boundary layers

### **Heat Transfer**

- o Heat transfer mechanisms: conduction, convection, radiation
- o Thermal resistance networks
- o Heat exchangers: characterization, analytical description

### **Production System Engineering**

- o Flow-sheeting: block diagram, process flow diagram (PFD), piping and instrumentation diagram (PID), process control engineering (PCE)
- o Friction losses: pressure drop, cavitation, NPSH, total head
- o Duty point curves: system curve, pump curve, efficiency optimization
- o Plant equipment: types of pumps / valves, pipe selection
- o Modes of operation

### **Intended Lab Sessions**

- o Determination of the rheological behaviour of different fluids in a rotational viscosimeter
- o Determination of the thermal conductivity of different metals
- o Verification of the Stephan-Boltzmann Law
- o Determination of the convective heat transfer coefficient
- o Determination of the flow properties for laminar / turbulent flow
- o Determination of the pipe friction factor for laminar / turbulent flow
- o Determination of energy losses of piping instrumentation
- o Behaviour / properties of a centrifugal pump

### **Teaching Methods**

The lecture focuses on seminaristic teaching, but also applies detailed practical exercises based on the theoretical background. The key content is denoted in

a written script via visualizer, while the supplemental content is conveyed via slide and video presentations. All material is uploaded to an online learning portal (iLearn). The students are strongly invited to discuss real-life problems and applications interactively throughout the lecture. Lab sessions on state-of-the-art experimental set-ups and lab equipment support the students in getting hands-on experience and thus transfer their theoretical knowledge into practice. Tutorials will be offered on demand.

## Remarks

Although the lecture is taught in English, the focus lies on the application of German norms and standards in plant engineering (some selected German literature inevitable). In order to substantiate the lessons learnt, it is planned to offer an excursion to an industrial production site.

## Recommended Literature

- o Y.A. Cengel, J.M. Cimbala "Fluid Mechanics - Fundamentals and Applications", McGraw Hill, 4th edition 2018
- o Y.A. Cengel, A.J. Ghajar "Heat and Mass Transfer - Fundamentals and Applications", McGraw Hill, 5th edition 2015
- o R. Sinnott, G. Towler "Chemical Engineering Design", Butterworth-Heinemann, 5th edition 2009
- o R. Chhabra, V. Shankar "Coulson and Richardson's Chemical Engineering Vol. 1A: Fluid Flow - Fundamentals and Applications", Butterworth-Heinemann, 7th edition 2018
- o K.A. Solen, J.N. Harb "Introduction to Chemical Engineering", Wiley, 5th edition 2011
- o C.J. Geankoplis, A.A. Hersel, D.H. Lepek "Transport Processes and Separation Process Principles", Prentice Hall, 5th edition 2018
- o E. Ignatowitz "Chemietechnik", Europa-Lehrmittel, 12th edition 2015
- o W. Bohl, W. Elmendorf "Technische Strömungslehre", 15th edition 2014
- o H.D. Baehr, K. Stephan "Wärme- und Stoffübertragung", Springer, 9th edition 2016
- o G. Vetter "Rotierende Verdrängerpumpen für die Prozesstechnik", Vulkan, 1st edition 2006
- o W. Eifler, E. Schlücker, U. Spicher, G. Will "Küttner Kolbenmaschinen", Vieweg, 7th edition 2009
- o various German and international norms and standards (announced in the lecture)

## IE-30 MANAGEMENT

Module code	IE-30
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Lean Management Management
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Professional competence

##### Knowledge

- o Know and understand the basic principles and methods of HR Management.
- o Know and understand the basic principles and methods of Lean Management (focus on Lean Production).
- o Know and understand the fundamentals of German Labour Law.

##### Skills

- o Ability to judge on legal questions with respect to German Labour Law.
- o Ability to choose and apply production management methods.

#### Personal competence

##### Social competence

- o Ability to apply personal feedback techniques.
- o Ability to adjust self and public image.

- o Ability to apply communication techniques in one-on-one settings.
- o Ability to understand the value of each employee for a company's success.

#### Autonomy

- o Understand roles and dependencies in hierarchy.
- o Understand fundamental dimensions of personalities.

## **Applicability in this and other Programs**

Internship, Bachelor Thesis

## **Entrance Requirements**

Applied Mathematics (IE-14)

## **Learning Content**

### **HR Management**

- o Introduction into roles within a company
- o Introduction into methods of people management
- o Introduction into aspects of change management
- o Introduction into personnel development
- o Introduction into personality models
- o Introduction into relevant communication settings and their application
- o Introduction into management techniques/styles
- o Forms of employment
- o Cancellation of contracts
- o Introduction into relevant legal situation
- o Introduction into relevant HR processes

### **Lean Management**

- o Continuous Improvement (PDCA, Kaizen)
- o Waste Identification and Elimination (Toyota's Seven Wastes)
- o Customer-Focused Quality (TQM)

- o Elements of Lean Production (Pull Production, Mistake-Proofing)

## Teaching Methods

Seminaristic teaching / roleplay / discussions / assignments

## Recommended Literature

### HR Management

J. E. Pynes, Human Resources Management, Possey-Bass

J. Rowold, Human Resource Management, Springer

S. Lingemann, R. von Steinau-Steinrück, A. Mengel, Employment & Labor Law in Germany, Beck

J. Kirchner, P. Kemp, M. Magotsch, Key Aspects of German Employment and Labour Law

Herzberg, Frederick; Mausner, Bernard; Snyderman, Barbara Bloch: The Motivation to Work. Wiley

J. Marques, S. Dhiman, Engaged Leadership, Springer

Buckingham, Coffman, Erfolgreiche Führung gegen jede Regel, Campus Verlag, 3.Auflage, 2005

Malik, Führen, Leisten, Leben - Wirksames Management für eine neue Zeit, Campus Verlag, 2006

Mathieu Weggemann, Wissensmanagement, mitp-Verlag, Landsberg

### Lean Management

John Nicholas, Lean Production for Competitive Advantage, 2nd edition, 2018

Pascal Dennis, Lean Production Simplified, 3rd edition, 2015

## IE-31 RENEWABLE ENERGIES

Module code	IE-31
Module coordination	Prof. Dr. Raimund Brotsack
Course number and name	IE-22 Renewable Energies
Lecturer	Prof. Dr. Raimund Brotsack
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

Based on the analytical, mathematical and scientific foundations of engineering (physics and chemistry), students learn about the sources and selected technologies for the use of renewable energies. Students know the sources of regenerative energies (sun, gravitation, geothermal energy) and their engineering applications for the conversion of energy systems. The module develops competences and skills in the evaluation of potentials and options for technical applications of renewable energies.

#### Professional competence:

##### *Knowledge*

Understanding the fundamentals of energy, forms of energy and performance, climate change - greenhouse effect, processes in the atmosphere as well as the basics of bio-energy (plants, photosynthesis, chemical building blocks), the finite nature of fossil resources and the fundamentals for the evaluation of renewable energy systems - sustainability, selected technologies of renewable energy systems and energy storage research.

##### *Skills*

Students are able to use the acquired knowledge to describe, analyse, plan and apply the technologies in the field of the conversion of energy systems. Calculation examples enhance these skills.

### **Method competence:**

The students improve the knowledge in the field of renewable forms based on real case studies. The students should be enabled to apply the acquired knowledge and to critically evaluate and inter-present subject-specific information on the basis of chemical and physical basics. Students develop a analytical system oriented way of thinking.

### **Social competence:**

- o Students develop analytical thinking and learn to discuss technical aspects in an analytical objective manner.

## **Applicability in this Program**

IE-17 Sustainability

## **Applicability in this and other Programs**

ESE-22, Renewable Energies, Bachelor Energy Systems Engineering at ECRI/THD

Y-09 Regenerative Energien 1, Bachelor Umweltingenieurwesen at THD

D-30 / D-7106 Regenerative Energie- und Stofftechnik, Bachelor Maschinenbau at THD

W-17, Regenerative Energien und Stofftechnik, Bachelor Wirtschaftsingenieurwesen at THD

## **Entrance Requirements**

Recommended requirements

- o Analytical Principles of Engineering (IE-01)
- o Mathematics for Engineering (IE-07)
- o Physics (IE-11)
- o Energy Technology (IE-16)
- o Fundamentals of Electrical Engineering (IE-15)
- o Chemistry (IE-18)

## **Learning Content**

- o Basics about energy / forms of energy / power
- o Sources of renewable energies: solar energy - light, geothermal energy, gravitation - tides
- o finiteness of fossil resources
- o energy conservation and recovery
- o energy storage and regulation
- o water power, hydroelectric power stations, and storage power stations; tidal power stations; solar power: thermal solar power stations, photovoltaic energy conversion; wind power: operation of wind farms, solar chimney power stations; geo-thermal energy; bioenergy
- o sector coupling between renewable energy resource and the electric grid
- o "Energiewende" in Germany
- o energy supply in the near future and future perspectives

## Teaching Methods

seminaristic teaching / exercises / tutorials / home work

Excursion to companies and research facilities (f.e. Technology Center for Energy; TZE, Ruhstorf an der Rott)

## Remarks

- o Excursions to companies and/or research institutions serve the purpose of in-depth
- o Transfer of practical knowledge or current research topics

## Recommended Literature

- o Godfrey Boyle; „Renewable Energy“, 3rd. Edition (13. September 2012), Oxford University Press; ISBN-10: 0199545332; ISBN-13: 978-0199545339
- o Andy Mccrea; „Renewable Energy“; neue Auflage (18. Februar 2013); The Crowood Press Ltd; ISBN-10: 1847974791; ISBN-13: 978-1847974792
- o Quaschnig V.: „Regenerative Energie-systeme“, 9. Auflage; Hanser Verlag München; 8. 2015
- o Wesselak, V.; Schabbach, T., et al.; „Regenerative Energietechnik“; Springer Verlag Berlin Heidelberg, 2te Auflage 2013
- o Kaltschmitt, M., Streicher, W., Wiese, A. (eds.), 2007, Renewable Energy: Technology, Economics and Environment, Springer. Heidelberg

- o Harvery, D., 2010, Energy and the New Reality 2: Carbon-Free Energy Supply, Eathscan, Lon-don/Washington
- o Boyle, G. (ed.) 2004, Renewable Energy: Pow-er for a Sustainable Future, 2nd Edition, Open University Press, Oxford
- o Struchtrup, H., 2014, Thermodynamics and Energy Conversion, Springer. Heidelberg
- o Demirel, Y., (2nd ed.), 2016, Energy: Produc-tion, Conversion, Storage, Conservation, and Coupling

## IE-32 PROJECT WORK

Module code	IE-32
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Project work with report
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	6
ECTS	5
Workload	Time of attendance: 90 hours self-study: 60 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Professional competence

##### Knowledge

- o Know and understand the principles, processes and tools of project management.
- o Students need to work themselves independently into a new work field / work area.

##### Skills

- o Ability to apply systematic approaches to practical work.
- o Ability to independently manage a project or part of a project.
- o Ability to present and communicate results of the work in an oral presentation and a report.
- o Practical skills in dependence of the project.

#### Personal competence

##### Social competence

- o Ability to work task-oriented in small mixed groups, leveraging different skills in the team.
- o Ability to prioritize tasks.
- o Ability to escalate problematic issues.

#### Autonomy

- o Show ability to structure, plan and execute tasks around a new project.
- o Show skills in issue management.
- o Ability to re-plan if issues cannot be solved.

## **Applicability in this and other Programs**

Specific for IE study program.

## **Entrance Requirements**

Successful passing of fundamental courses.

## **Learning Content**

- o Students work in teams on real engineering projects.
- o Team sizes varies (project dependent) in between 2 - 8 students.
- o A given task need to be structured and executed.
- o Task consist of (and might combine)
  - o Technical planning
  - o Technical design
  - o Specification desing
  - o Building of items/electronics
  - o Programming
  - o Numerical simulation
  - o Technical implementation
  - o Operation
  - o Optimization

## **Teaching Methods**



Independent work. Supervision by professors and technicians/lab engineers.  
Counseling if needed.

## **Recommended Literature**

Varies - specific to the project.

## IE-33; IE-34; IE-35 INTERNSHIP INCLUDING PLV 1 AND PLV 2

Module code	IE-33; IE-34; IE-35
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	IE-33 Internship IE-34 IE-35
Semester	6
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	30
Workload	Time of attendance: 90 hours self-study: 810 hours Total: 900 hours
Type of Examination	presentation 20 min., internship certification
Weighting of the grade	30/210
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

- o Understand the processes and procedures of a company.
- o Understand the requirements in the professional live.
- o Understand basic techniques around application preparation, presentation and communication.

##### Skills

- o Ability to apply gained knowledge in a professional/commercial setting.
- o Ability to access new work areas.
- o Ability to evaluate real-life problems and to design and apply solution approaches.
- o Ability to evaluate and explain the achievements and learnings.

## **Personal competence**

Social competence

- o Ability to integrate into teams with more experienced professionals.

Autonomy

- o Succeed professionally in a new environment.
- o Learn how to autonomously achieve results.
- o Learn how to gain a position in industry.

## **Applicability in this and other Programs**

Applicable in all technical programs with practical semester.

## **Entrance Requirements**

For internship: 120 ECTS and PLV1 finalized.

For PLV2: Internship finalized.

## **Learning Content**

PLV 1 seminars: Seven workshops, thereof four in the personal competence area and three in the professional competence area (to be selected from the overall course offering of the International Office and Career Services).

Workshops include:

- o Application skills
- o Interview training
- o Communication training
- o Presentation trainings
- o MS-Office trainings
- o Intercultural training
- o Job skills
- o Pyramidal communication

PLV 2 seminar: One week of training in advanced presentation techniques and communication. Each student has to give a 20 minute presentation on the content of his internship.

Internship: 18 week full time internship in a field which is related to industrial engineering. The internship can be planned with any German company or a research institute. Student's who want to do the internship in an international context need to get approval by the Practical Responsible Professor. The Practical Responsible Professor decides on whether a job is accepted for the internship.

## **Teaching Methods**

Seminaristic workshops.

Practical work.

## **Recommended Literature**

Depends on subject of internship.

## IE-37 BACHELOR MODULE

Module code	IE-37
Module coordination	Prof. Dr. Michelle Cummings-Koether
Course number and name	IE-7014 Bachelor thesis IE-7015 Applied communication techniques
Lecturers	Prof. Dr. Michelle Cummings-Koether Bernadette Busler Franziska Durner
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	15
Workload	Time of attendance: 60 hours self-study: 390 hours Total: 450 hours
Type of Examination	oral examination, bachelor thesis
Weighting of the grade	15/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

- o The students are in possession of necessary knowledge of theories and methods for addressing complex engineering problems
- o The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject
- o The students can position a research task in their subject area in its context, describe and critically assess it
- o Students are able to explain and apply basic principles and methods for planning and structuring project work as well as adequate communication technics employed in professional collaborations and for dissemination of results

##### Skills



- o Students are able to independently address complex scientific problems
- o The students are able to select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question
- o Applying the methods, they have acquired during their studies the students can analyze problems, make decisions on technical issues, and develop solutions.
- o The students can take up a critical position on the findings of their own research work from a specialized perspective.
- o The students are able to work alone and in teams, structure and plan their work, communicate appropriately with partners, present the addressed problem and discuss the obtained results

### **Personal competence**

### **Social competence**

- o Students can outline a scientific problem for an expert audience accurately, understandably and in a structured way both in written and oral communication
- o Deal with issues competently in an expert discussion and answer them in a manner that is appropriate for the audience

### **Autonomy**

- o The students are able to apply the techniques of scientific work comprehensively on their own to connect knowledge and material necessary for working on an engineering or research problem
- o The students are capable of structuring on their own an extensive work in task and process them within a specified time frame
- o The students are capable of individually presenting their work and results in a scientific style employing appropriate communication techniques

## **Applicability in this and other Programs**

Bachelor of Industrial Engineering

## **Entrance Requirements**

According to the study and examination regulations of the Bachelor of Industrial Engineering study programme, Section 11 - Bachelor's dissertation (2):

Students who have attained 150 ECTS credit points can enrol for the bachelor module and thesis.

## **Learning Content**



The module provides training in applied communication techniques and the possibility for the students to demonstrate their ability to independently apply the knowledge and skills acquired during the academic studies to address a larger engineering problem. Concrete topics and problems will be independently addressed and developed based on scientific research methods and documented within a written final Bachelor thesis.

The seminar on applied communication techniques is focusing on:

- o Writing in academic style with clarity and accuracy
- o Referencing with accuracy and plagiarism
- o Giving effective presentations
- o Time management and harmony of the presentation
- o Dimensions and levels of communication
- o Nonverbal communication and emotions
- o Body language and facial expressions
- o Impact of your nonverbal communication on others
- o Culture and its impact on communication

At the end of the bachelor project the students should make oral presentations applying the communication competencies gained in the applied communication techniques part of the module. The presentation should address their bachelor project work and its outcomes.

The Bachelor thesis can be written in English or German language.

## Teaching Methods

Self-reliant working / seminaristic teaching / team working

## Recommended Literature

Thesis:

- o Eco U., Schick W., Wie man eine wissenschaftliche Abschlussarbeit schreibt, 13. Auflage, UTB 2010
- o Ebel Hans Friedrich, Bliefert Claus, Bachelor-, Master- und Doktorarbeit, 4. Auflage, Wiley-VCH Verlag 2009
- o Charles Lipson, How to Write a BA Thesis: A Practical Guide from Your First Ideas to Your Finished Paper, Chicago Press 2005

- o As well as depending on the selected topic and area of expertise

Applied communication techniques:

- o Diana Hopkins, Tom Reid, The Academic skills handbook: your guide to success in writing, thinking and communicating at university, Sage 2018
- o Frank Garten, The international manager: a guide for communicating, cooperating, and negotiating with worldwide colleagues, CRC Press 2015

## ► **IE-7014 BACHELOR THESIS**

### **Type of Examination**

bachelor thesis

## ► **IE-7015 APPLIED COMMUNICATION TECHNIQUES**

### **Objectives**

This course is designed to help students effectly learn how to communicate and present scientific and professional results on different levels.

After completing the course, the students are expected to have the following competences and skills.

#### **Professional competence and skills:**

- o Develop knowledge and understanding of key theories, concepts and models and be able to present these.
- o The ability to differentiate between the different types of resources and apply a critical analysis to these.
- o To better understand and solve cultural and communication problems, and to recognize how these affect international working environments.
- o Have improved communication, rhetoric and presentation skills, and to apply these especially to scientific communication.

#### **Method competence:**

- o They will be able to combine previously acquired skills and theory with communication skills, to better be able to communicate on a scientific level in differing fields.
- o They can rationalize which communication approaches will be best suited for various situation.

- o They will be able to combine approaches from interdisciplinary fields, in order to communicate more effectively and individually.

#### **Personal and social competences:**

- o The ability to understand one's own limitations in effectively gathering scientific evidence, and be able to apply tools that can help them succeed.
- o Increased self-confidence in presenting scientific results
- o Students will develop written and verbal presentational skills.
- o They can demonstrate group-work, questioning and listening skills.

#### **Learning Content**

The following concepts are emphasized in theoretical discussions, presentations, group work and case studies:

- o What is scientific communication
- o How to present scientific results in an academic and in professional environments
- o Theoretical background on standards of scientific work and publication
- o Organizational culture in an international environment
- o Advanced rhetoric and presentation skills in the academic and business environment
- o Argumentation skills
- o Communication across various scientific cultures
- o Learn the tools that can be used to effectively write and present scientific content
- o Learn the rules of citation in academic work on hand of the use of APA rules

More topics can be added depending of progress of the discussion, or to include student questions.

#### **Entrance Requirements**

English skills

#### **Type of Examination**

oral ex. 30 min.

#### **Methods**

Interactive lectures, discussions, presentations, group work, self-study and case-studies.

## **Recommended Literature**

Recommended reading (if possible, in the most current edition):

- o American Psychological Association (2020). Publication Manual of the American Psychological Association: 7th Edition. Washington, D.C.: American Psychological Association.
- o Hoffmann, A. H. (2020). Scientific Writing and Communication :Papers, Proposals and Presentations. New York: Oxford University Press

## IE-ELECTIVE BUSINESS PLANNING AND START-UP MANAGEMENT

Module code	IE-Elective
Module coordination	Prof. Dr. Tobias Bader
Course number and name	Business Planning and Start-Up Management
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	report/presentation
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

Students learn about the general aspects of building a start-up company and strategies regarding innovation management.

#### professional competence:

##### *Knowledge*

- o Students know how to applicate tools for analysis and management in business theory and praxis.
- o They are familiar in entrepreneurial thinking and dealing.
- o Students understand basic principles of business development, business planning and start-up and innovation management.

##### *Skills*

- o Students understand the theoretical principles of strategic management.
- o Students understand the importance of continuous and structured active business development and being able to choose and apply adequate business planning/management tools in professional practice.

**Method competences:**

- o Students are able to structure a project independently and draw up a binding schedule with realistic milestones, as well as carry out a progress check.
- o Through the teaching of the fundamental elements of innovation management, student should be in a position to analyse the innovation process in a company, recognize the opportunities and risks of innovations and be able to actively organise the innovation-management of a company.
- o They are able to present own ideas in form of a small business plan.

**Social competence**

- o Ability to work in intercultural mixed teams and communicate their progress and results while creating an own small business plan.

**Applicability in this and other Programs**

W-7104 Gründungsmanagement und Businessplan, BA Wirtschaftsingenieurwesen at THD

A-6104 Management Business-Plan-Seminar, BA Betriebswirtschaft at THD

**Entrance Requirements**

Principles in Business (IE-05)

Scientific Writing, Research Methods and Project Management (IE-17)

Financing (IE-20)

Management (IE-31)

**Learning Content***Business Planning and Start-Up Management*

- o application of the tools of analysis and management in business theory and practice
- o structuring of projects with time and milestone planning
- o set out realistic project targets with use of resources and cost-benefit analysis
- o control of project development and monitoring of target achievement including fall-back solutions for emergencies
- o training in entrepreneurial thinking and dealing

*Innovation Management*

- o principles of innovation management and strategic innovation planning
- o customer benefits through innovation
- o creative processes and systematic brainstorming
- o evaluation and selection of ideas, feasibility check and development planning
- o intellectual property tools

## **Teaching Methods**

seminaristic teaching / project work in groups

## **Remarks**

Business planning in small groups in the basis of own ideas.

## IE-ELECTIVE DATA ACQUISITION AND PROCESSING

Module code	IE-Elective
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Data Acquisition and Processing
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	report/presentation
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

Students are able to explain and reproduce basic theories, principles, and methods related to:

- o Basics of data acquisition
- o Discrete-Time Signals and Systems
- o Discrete-Time System properties, Linear Time-Invariant (LTI) Systems
- o z-Transform and its application to LTI systems
- o Transient and Steady-State responses
- o Frequency analysis of signals, the Fourier analysis
- o Frequency response of LTI Systems
- o Implementation of Discrete-Time Systems

- o Implementation of Finite-duration Impulse Response (FIR) and Infinite-duration Impulse Response (IIR) digital filters

### **Skills**

- o Ability to apply Digital Signal Processing methods in developing signal processing procedures
- o Ability to design and implement Discrete-Time Systems, i.e. digital filters
- o Ability to employ scientific graphing, data analysis, data processing and programming software tools

### **Personal competence**

#### **Social competence**

- o Team working on applying theoretical concepts of data processing to practical applications.
- o Students jointly develop ideas and deal creatively with questions in workshops or working groups.
- o Team coaching: Students help each other by giving feedback and objective criticism.

#### **Autonomy**

- o Analytical thinking and attention to details
- o Ability to consider different strategies to solve problems

## **Applicability in this and other Programs**

Bachelor of Industrial Engineering

## **Entrance Requirements**

Informatics for Engineering II (IE-08), Fundamentals of Electrical Engineering (IE-15) and Applied Measurement and Control Engineering (IE-27) are recommended

## **Learning Content**

The module provides an introduction to data analysis and processing, addressing:

- o Fundamentals of data acquisition and processing, advantages of digital over analog signal processing
- o Introduction to Discrete-Time Signals and Systems
- o Continuous-Time versus Discrete-Time signals

- o Continuous-Valued versus Discrete-Valued signals
- o Sampling of analog signals, the Sampling Theorem
- o Discrete-Time Processing of Continuous-Time Signals
- o Analog-to-Digital (ADC) and Digital-to-Analog Converters (DAC), sampling and oversampling
- o Quantization errors and coding
- o Discrete-Time Systems, Block Diagram representation
- o Analysis of discrete-time Linear Time-Invariant Systems (LTI) and stability
- o Systems with Finite-duration and Infinite-duration Impulse Response (FIR and IIR)
- o Implementation of Discrete-Time Systems, recursive and nonrecursive realizations of FIR systems
- o The z-Transform and its application to the analysis of LTI systems
- o Analysis of LTI systems in the z-domain
- o Transient and Steady-State responses
- o Frequency analysis of signals, the Fourier analysis
- o Power Density Spectrum and Energy Density Spectrum
- o Frequency-Domain analysis of LTI systems
- o Frequency response of LTI systems
- o LTI systems as Frequency-Selective Filters and Resonators
- o Implementation of Discrete-Time Systems, FIR and IIR Structures
- o Direct-Form, Cascade-Form, Frequency-Sampling and Lattice Structures

Practical computer-based sessions are enabling the students to consolidate the theoretical knowledge as well as to develop practical skills in implementing and testing data processing algorithms as well as to learn to employ scientific graphing and data analysis software tool for that purpose. Team-working on assignments are further developing collaborative problem-solving skills and consolidating their knowledge base.

## Teaching Methods

Seminaristic teaching / work on computer/ practical exercises and assignments / home work

Whiteboard, PowerPoint presentation, document camera (visualiser) and additional lecture materials in iLearn

Use of Computers: students work individually and in groups on practical examples and on implementations of digital processing algorithms.

## Recommended Literature

- o Digital Signal Processing, International Edition, 4/E, John G. Proakis, Dimitris K Manolakis, Pearson 2014, ISBN 978-1-292-02573-5
- o Essentials of digital signal processing using MATLAB, 3rd International ed, Vinay K. Ingle, John G. Proakis, Cengage Learning 2012, ISBN 978-1-111-42737-5
- o Signalverarbeitung: Analoge und digitale Signale, Systeme und Filter, Martin Meyer, Springer 2014, ISBN 978-3-658-02612-7
- o IgorPro a scientific graphic, data analysis and programming tool for scientists and engineers WaveMetrics Inc. <https://www.wavemetrics.com/>

## IE-ELECTIVE ENERGY AND RESOURCE EFFICIENCY

Module code	IE-Elective
Module coordination	Prof. Dr. Rui Li
Course number and name	Energy and Resource Efficiency
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

The students should understand and apply the basic principles of the energy conversions, the technical aspects of energy and resource management. They will learn that the energy manager nowadays has many opportunities to reduce utility costs by using energy procurement strategies.

#### Professional competences:

- o The students can understand the least expensive and most efficient in this endeavor is energy conservation, rather than more energy production.
- o The core concept: improving energy efficiency increases the productivity of basic energy resources by providing the needs of society with less energy.
- o Implement some efficiency analysis in some certain energy devices.
- o Energy conversion and distribution during the power generations.
- o Interactions between: energy procurement, raw material procurement, energy consumption and production planning.
- o Technical aspects of energy and resource management: lifecycle costs, investment costs, manufacturing costs.

- o Energy management strategies in different countries.

### **Method competence:**

The students are able to present and classify different calculation methods for different apparatus and machinery drives in the industry. They know the methods to improve the efficiency across all sectors of the economy. They are familiar with energy and resource management systems and standards.

### **Personal and social competences:**

- o Access and evaluate the ways of energy conservation in its various forms that are the cornerstones of a successful national energy strategy.
- o Communication skills to argue that the best way to protect the environment and reduce global warming is a higher energy efficiency with a reasonable energy management.

## **Applicability in this and other Programs**

BA Wirtschaftsingenieurwesen at THD

Mechanical Engineering

And any other study programme that deals with energy technology, energy management standards.

## **Entrance Requirements**

Energy Technology (IE-16)

Renewable Energies (IE-22)

Plant Engineering (IE-23)

Sustainability (IE-30)

## **Learning Content**

- o Core concepts and basic points on resource and energy efficiency and management
- o Basic calculations of energy efficiency for different power cycles
- o Conventional fossil resources distributions, transport and utilization
- o Efficiency and irreversible losses of apparatus and machinery drives: pumps, fans, blowers, compressors, filters, dryers, stirrers, heat exchangers, conveyors, indoor air quality

- o Process analysis and optimization: energy benchmarks, pinch analysis, heat integration, evaluation of alternative technology
- o Introductions of energy and resource management systems: e.g. DIN EN 16001, VDI Guidelines 4661, technical benefits of energy management systems
- o Project definition and implementation, operational responsibilities, employees: training and motivation

## Teaching Methods

seminaristic teaching / exercises / tutorials / home work

## Recommended Literature

- o Harvery, D., Energy and the New Reality 2: Carbon-Free Energy Supply, Eathscan, 2010,
- o Yogi Goswami D.: Handbook of Energy Efficiency and Renew-able Energies, CRC Press, 2016
- o Struchtrup, H., Thermodynamics and Energy Conversion, Springer, Heidelberg, 2014,
- o Demirel, Y., Energy: Production, Conversion, Storage, Conservation, and Coupling, 2016,

## IE-ELECTIVE ENERGY MARKETS

Module code	IE-Elective
Module coordination	Prof. Dr. Rui Li
Course number and name	Energy Markets
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

The energy industry is one of the most capital-intensive and fastest-growing industries in the world. The course offers the understandings of energy and power systems in regulated and competitive environments and implications on business decisions for firms in these industries. As a typical cross-disciplinary course, it is assumed that these students, before the lecture, already are familiar with the physical structure of power systems, understand the purpose and principles of a power flow calculation with basic optimization theory. After completing the course, the students are expected to have the following competences.

#### Professional competence:

- o Develop knowledge and understanding of key theories, concepts and models in energy marketing.
- o Familiar with conventional and renewable energy resources in Europe and all over the world.
- o Understand a solid working knowledge of the mechanisms of energy markets.
- o Acquire the deep understanding of supply and demand dynamics.

- o Obtain an overview over energy marketing communication and the steps to marginal cost.
- o Analyze key elements in electricity market economics and the constitution of locational marginal price.
- o The political and financial impact on the energy price should be fully understood.
- o Analyze the impact of transmission congestion on pricing and the risk management policies.

### **Method competence:**

The students are able to understand how the economics affect the physics and how the physics constrain the economics. They have a solid understanding of the basics and help them develop innovative solutions to problems that vary in subtle ways from country to country, from market to market and from company to company.

### **Personal and social competences:**

- o The students can apply economic fundamentals and the institutional knowledge needed to implement sound economic decisions relating to energy market.
- o The students are expected to have the competence of the modeling, information acquisition, critical thinking and communication skill directly to the minds of the engineers, manager or decision makers.
- o With a broader perspective, the students can read the related literature and to continue to grow and learn beyond this lecture.

## **Applicability in this and other Programs**

This module is an elective lecture in the last semester of studies, so there will be no direct applicability within the same study programme. However, the learning outcomes can be applied in any other study programmes including the combination of energy and economics.

## **Entrance Requirements**

IE-16 Energy Technology

IE-22 Renewable Energies

IE-20 Financing

## **Learning Content**

- o Analysis of the operation of power systems in a competitive environment

- o Analysis of the operation of pure energy markets: gas, oil, coal, and electricity market architecture
- o Smart grid and renewable energy in electricity markets
- o Power system security and the effects that networks have on electricity prices
- o Risk and risk management in energy market
- o Issue of investments in power generation and transmission equipment in a competitive environment
- o Impact of financial market trends
- o Impact of political policy, energy transition (Energiewende) in Germany

## **Teaching Methods**

seminaristic teaching / exercises / tutorials (case study) / group discussion

## **Recommended Literature**

- o Carol A. D.: International Energy Markets: Understanding Pricing, Policies and Profits, 2e, Pennwell Corp , 2015
- o Tom J.: Energy Markets: Price Risk Management and Trading, Wiley Finance, 2007
- o Gianna B.: Investing in Energy, Bloomberg Press, 2011

## IE-ELECTIVE GLOBALISATION

Module code	IE-Elective
Module coordination	Prof. Dr. Matthias Huber
Course number and name	Globalisation
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	report/presentation
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

Globalisation is a contested concept: for the students after successfully six semesters of study program, this elective course gives a solid intellectual foundation to prepare them to become global students.

#### Professional competence:

##### *Knowledge*

- o Understand what is meant by the term globalization.
- o Describe the changing nature of the global economy.
- o Identify the macropolitical and economic changes occurring worldwide.
- o Recognize how differences in social culture influence values in business.
- o Understand why nations trade with each other.
- o Summarize the different theories explaining trade flows between nations.
- o Understand what is meant by spot exchange rates.
- o Describe the historical development of the modern global monetary system.
- o Explain the concept of international business strategy.

- o Explain the promises and risks associated with exporting.

#### *Skill*

- o Ability to understand and describe the changing nature of the global economy.
- o Ability to identify the roles they should take in their lives to cope with global issues such as environmental deterioration, population explosion, and wealth gap.
- o Ability to apply the concept of globalization and its impact in the areas where it has had an effect: production, governance, identity, knowledge.

#### **Method competence:**

After finishing this lecture, students will be able to understand how the process of globalization is creating opportunities and challenges for management practice. They can also explain the role played by the World Bank and the IMF in the international monetary system. Additionally, students are able to apply the basic steps involved in export and import financing.

#### **Personal and social competence:**

- Demonstrate and access the further knowledge of the interconnectedness of global dynamics from different perspectives (history, issues, processes, trends).
- Reflect their knowledge of the interconnectedness of global dynamics case by case.

### **Applicability in this and other Programs**

This module is an elective lecture in the last semester of studies, so there will be no direct applicability within the same study programme. However, the learning outcomes can be applied in any other study programmes that deal with the subject of globalization and international relations.

### **Entrance Requirements**

IE-20 Financing

IE-29 Intercultural Competences

IE-31 Management

### **Learning Content**

- o Globalization and the impact of globalization
- o National differences in economic development, differences in culture
- o International trade theory
- o The foreign exchange market and the international monetary system

- o The strategy of international business
- o Exporting, importing, and countertrade
- o Global production and supply chain management
- o Global human resource management

## Teaching Methods

seminaristic teaching / exercises / group discussion / case study

## Recommended Literature

Recommended reading (if possible in the most current edition):

- o Charles W.L.: Global Business Today, 9th edition, Hill, 2015.
- o Jackson, Robert M. Ed: Global Issues, The Dushkin Publishing Group, Guilford, 2001
- o Lane, H.W. & Maznevski, M.L. (2019). *International Management Behavior: Global and Sustainable Leadership*. Cambridge, UK: Cambridge University Press.
- o Pickering, Kevin T., and Lewis A. Owen: An Introduction to Global Environmental Issues, Routledge, New York, 1997
- o Ulrich V.: Regional Integration, Economic Development and Global Governance, Edward Elgar 2011

## IE-ELECTIVE INDUSTRIAL AUTOMATION AND INFORMATION TECHNOLOGY

Module code	IE-Elective
Module coordination	Wolfgang Schauer
Course number and name	Industrial Automation and Information Technology
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	Undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	Portfolio
Weighting of the grade	5/210 ECTS
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

Students are able to explain and reproduce basic theories, principles, and methods related to:

- o Characteristic components of an automation system and have good understanding of their interaction
- o Systematical analysis of automation tasks and are able to use them
- o Properties of processes and explain methods for process analysis
- o Logical design of industrial automation
- o How an industrial programmable logic controller operates
- o Operation principles of various processing hardware used for automation
- o Principles of process flow control and monitoring
- o Software design concepts

- o Industrial Networks
- o Principles of field bus systems and how to use them
- o Factory level control and supervision
- o Smart Factory technologies and Industry 4.0
- o Big Data aspects of industrial and factory business systems

### **Skills**

Students are capable of:

- o Developing application-based concepts and solutions in automation to solve technical problems
- o Analysing complex automation tasks
- o Comparing methods for process modelling and select an appropriate method for actual problems
- o Developing programs for programmable logic controllers
- o Designing and implement user interfaces and human machine interfaces
- o Implementing communication using different field buses and network protocols
- o Reflecting their knowledge in practical applications and document the results of their work

### **Personal competence**

#### **Social competence**

Students are able to:

- o Work out solutions together in small groups
- o Develop solutions in a production environment with qualified personnel at technical level

#### **Autonomy**

Students are able to:

- o Analyze automation tasks independently
- o Develop programs for programmable logic devices autonomously
- o Develop solutions for practice-oriented tasks of automation independently
- o Assess consequences of their professional actions and responsibilities

## Applicability in this and other Programs

Bachelor of Industrial Engineering

## Entrance Requirements

Informatics for Engineering II (IE-08), Fundamentals of Electrical Engineering (IE-15), Applied Measurement and Control Engineering (IE-27) and Plant Engineering (IE-23) are recommended.

## Learning Content

The Industrial Automation and Information Technology module is focusing to the following aspects:

- o Introduction to automation technology
- o Process systems and automated machinery
- o Automation and manufacturing
- o Basic Programming Principles of PLCs
- o Fundamentals of PLC Logic Programming
- o Analog and Digital Input/Output Configuration
- o Analog Programming and Advanced Control
- o Human Machine Interaction and User Interfaces
- o Process Control and Monitoring
- o Industrial automation networks
- o Field bus systems and control networks
- o Safety technologies in industrial networks
- o Concepts of Industry 4.0
- o Industrial and factory business systems
- o Smart Factory technologies
- o Big Data, Cyber-Physical Systems
- o Internet of Things

Practical computer-based and experimental sessions are further enabling the students to consolidate the theoretical knowledge as well as to develop practical skills in implementing and testing industrial automation applications.

Thematic workshop on automation topics, onsite or at an industrial partner are further developing collaborative problem-solving skills and cooperation dexterity with qualified personnel at technical level.

## Teaching Methods

Seminaristic teaching / exercises / home work

Whiteboard, PowerPoint presentation, document camera (visualiser) and additional lecture materials in iLearn.

Experiments in small groups using training material that relays on professional computer-based experimentation system where multimedia combines cognitive and hands-on training units into a comprehensive unified concept enabling students to consolidate theoretical building blocks and practical skills for a maximum learning effectiveness.

Workshop on industrial automation where students work individually and in groups on practical examples and on assignments implementing various automation tasks.

## Recommended Literature

- o Stamatios Manesis, Introduction to industrial automation, CRC Press, Taylor & Francis 2018
- o Jan Lunze, Automatisierungstechnik : Methoden für die Überwachung und Steuerung kontinuierlicher und ereignisdiskreter Systeme, De Gruyter Oldenbourg 2016
- o Frank Lamb, Industrial automation : hands-on, McGraw-Hill 2013
- o Boca Raton, Industrial communication technology handbook, CRC Press Taylor & Francis 2017
- o Alasdair Gilchrist, Industry 4.0 : the industrial internet of things, Apress 2016
- o Khaled Kamel, Eman Kamel, Programmable logic controllers : industrial control, McGraw-Hill 2014
- o Computer-based training material and experimentation systems on Automation Technology, UniTrain Course and Systems, Lucas-Nülle - <https://www.lucas-nuelle.com/>

## IE-ELECTIVE INSIGHTS INTO THE CORPORATE WORLD

Module code	IE-Elective
Module coordination	Claudia Hageneder
Course number and name	Insights into the Corporate World
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 0 hours Total: 0 hours
Type of Examination	schrP/Report/Präsentation/mdIP
Weighting of the grade	
Language of Instruction	English

### Module Objective

After completing the module **Insights into the corporate world** the students achieved the following learning outcomes of this module:

#### Professional Competence:

Students will be able to have an understanding about how local German and multinational, international companies are functioning. Starting from the establishing of a company, defining a Business Plan and Strategy. Followed by possibilities how to break down the strategy into objectives, targets and goals for departments and individuals.

#### Method Competence:

Additionally students will know about the different ways how to organize a company or a department and choose the most suitable kind of organization for a certain situation or business case.

Students will learn methods how to successfully manage a change process and how to form and manage successful teams.

As results of group exercises will be presented by the students, their presentation skills will be improved.

#### Personal and Social Competence:

Beside the theoretical knowledge the students will be also equipped with necessary

awareness of cultural difference and how to deal with this in the daily working life. As many exercises will be done as group work including presentations the students will understand how to work in teams and coordinate to reach a successful outcome.

## **Applicability in this and other Programs**

This module is an elective lecture in the last semester of studies, so there will be no direct applicability within the same study programme. However, the learning outcomes can be applied in any other study programmes including the combination of energy and economics.

## **Entrance Requirements**

There are no special entrance requirements.

## **Learning Content**

Learning Content

Strategy and Culture

- o Corporate Culture, Vision, Mission
- o Business Plan, Business Model Canvas
- o Corporate Values, Corporate Governance

Organization Theory and Reality

- o Line, Staff, Project and Matrix Organization
- o Agile Organization
- o Examples from the Corporate World
- o The process of a product through an Organization
- o Lifecycle Management
- o Team Building

Implementation of Strategy

- o Principles of ISO 9001
- o Management by Objectives
- o SMART Goals
- o Key Performance Indices

- o Review of Strategy and Objectives
- o Change Management

Political and Economic Situation on different continents

Intercultural Competence

- o Cultural Standards (Alexander Thomas)
- o Cultural Dimensions (Geert Hofstede)

## Teaching Methods

Lecture, Exercises, Group Work/Exercises, Presentation by Students  
Usage of Laptop / Projector, Board, Flip Chart

## Recommended Literature

- Drucker, Peter F., Innovations and Entrepreneurship, Harper, New York, 1993
- Collins, Jim, Built to Last, Harper, New York, 2002
- Collins, Jim, Good to Great, Harper, New York, 2001
- Nowotny, Valentin, Agile Unternehmen, BusinessVillage, Göttingen, 2016
- Jung, Hans, Allgemeine Betriebswirtschaftslehre, Oldenburg Verlag, München, 2000
- Siebenbrock, Heinz, Grundlagen der Organisationsgestaltung und -entwicklung, niederle media, Altenberge, 2014
- Ismail, Salim, Exponential Organizations, Diversion Books, New York, 2014
- Schreyögg, Georg, Grundlagen der Organisation, Springer Gabler, Wiesbaden, 2012
- Hofstede, Geert, Lokales Denken, globales Handeln, Deutscher Taschenbuch Verlag, München, 2011
- Thomas, Alexander, Beruflich in China, Vandenhoeck & Ruprecht, Göttingen, 2015
- Thomas, Alexander, Beruflich in Malaysia, Vandenhoeck & Ruprecht, Göttingen, 2006
- Thomas, Alexander, Beruflich in USA, Vandenhoeck & Ruprecht, Göttingen, 2013
- Schulz von Thun, Friedemann, Interkulturelle Kommunikation: Methoden, Modelle, Beispiele, Rowohlt Taschenbuch Verlag, Reinbeck, 2016
- Simmel, Christian Ignaz, Interkulturelle Personalführung am Beispiel von international agierenden Unternehmen, Peter Lang, Frankfurt am Main, 2015

## IE-ELECTIVE MODELLING THEORY

Module code	IE-Elective
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Modelling Theory
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

**This module aims to equip students with a comprehensive understanding of the fundamental concepts and methods of game theory to model and analyze strategic interactions. Upon successful completion of this module, students will be able to classify, formally describe, and analyze various strategic situations encountered in economic, political, and social contexts.**

#### *Expertise*

- o Students will know and understand the methods and strategies of non-cooperative and cooperative game theory.
- o Students understand the possibilities and limits of modeling interdependent decision situations.

#### *Methodological Competence*

- o Students are able to classify and formally describe various strategic interactions (games) in practice.
- o Students are able to conceptualize "rational behavior" and to identify adequate solutions for decision situations.

- o Students can independently identify, model, and analyze strategic aspects of economic, political, and social interactions.

#### *Personal Competence*

- o Students recognize the influence of intuition and societal expectations on decision-making.
- o Students are able to critically question the assumptions regarding rationality and self-interest in economic theory.
- o Students are able to relate their acquired knowledge to other lectures and topics.

#### *Social Competence*

- o Students are able to highlight different perspectives of a problem and work out solutions in teams.
- o The interactive character of the lectures and tutorials strengthens the students' discussion and presentation skills in the academic context.
- o Students are encouraged to actively participate in the course by choosing appropriate didactical methods and discussing real-life problems.

## **Applicability in this and other Programs**

The learning outcomes of this module can be applied in any lectures and other study programs that require a basic understanding of modelling and game theory. They form the basis of further application-oriented theorizing in areas such as institutional economics, industrial economics, behavioral economics, and information economics.

## **Entrance Requirements**

Principles in Business (IE-05), Applied Mathematics (IE-14), and Logistics and Operations Research (IE-21) are recommended.

## **Learning Content**

1. Theoretical framework
  - Representation of a game in extensive form
  - Representation of a game in strategic form
  - Mixed extension of a game
2. Strategic-form analysis
  - Dominance and iterative dominance
  - Nash equilibrium, existence
3. Refinements of Nash equilibrium
  - Subgame-perfect equilibrium
  - Weak perfect Bayesian equilibrium
  - Sequential equilibrium

## Teaching Methods

Seminaristic teaching combining topic-oriented lectures, exercises, group work, group presentations, and classroom discussions.

Students are encouraged to actively participate in course by choosing appropriate didactical methods. They are strongly invited to discuss real-life problems and applications interactively throughout the lecture.

The seminar is accompanied by tutorials where calculation examples from the course are repeated for better understanding and examples similar to those used during course sessions are calculated.

## Remarks

Teaching is supported by iLearn platform: Relevant course materials are made available online.

## Recommended Literature

### Basic literature

Gibbons R.; "A Primer in Game Theory"; Harlow: Prentice Hall, Pearson Education.  
Vega-Redondo F.; "Economics and the Theory of Games"; New York: Cambridge University Press.

### Supplementary literature

Fudenberg D., Tirole J.; "Game Theory"; Cambridge: MIT Press.  
Myerson R.B.; "Game Theory. Analysis of Conflict"; Harvard University Press.  
Mas-Colell A., Whinston M.D., Green J.R.; "Microeconomic Theory"; Oxford University Press.  
Dixit A.K., Skeath S., Reiley D.H.; "Games of Strategy"; New York: Norton.

## IE-ELECTIVE OPERATIONAL PROCESSES

Module code	IE-Elective
Module coordination	Prof. Dr. Rui Li
Course number and name	Operational Processes
Semester	7
Duration of the module	1 semester
Module frequency	
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

With focusing on organization, the students will be equipped with a thorough understanding by organization theory and together with management information systems.

#### Professional competence:

- o Understand the principles of organizational arrangements
- o Explain and demonstrate the organization structure, design, competitive strategies
- o Assess the outside environments and how organizations can respond to them
- o How to handle the operational information processing: fundamental management information systems concepts
- o Applications of information systems in business practice
- o Apply theoretical concepts to practical applications (case study)
- o Understand the direct and indirect connection between information systems and business performance

#### Method competence:



The students will be able to use the organizational theory by knowing concepts, structures and strategies. Students are allowed to have in-depth look at how today's business firms use information technologies and systems to achieve corporate objectives.

### **Personal and social competences:**

- o Students are able to develop analytical thinking, attention to details
- o Students are able to consider and analyze different strategies to solve problems from the organization point of view
- o Students are able to solve and discuss business problems in the field of information systems by applying systematic approaches and by identify alternative solutions in teams

## **Applicability in this and other Programs**

W-26 Betriebliche Informationssysteme, BA Wirtschaftsingenieurwesen at THD

And any other study programme that deals with organization theory and information management systems.

## **Entrance Requirements**

Principles in Business (IE-05)

Management (IE-31)

## **Learning Content**

- o Nature of organizations and organization theory
- o How strategies affect organization design
- o Basic concepts of organization structure
- o Major environmental forces on the organization
- o Information systems in global business
- o Information systems, organizations, and strategy
- o IT infrastructure and emerging technologies
- o Securing information systems

## **Teaching Methods**

seminaristic teaching / exercises / tutorials (case study) / home work

## Recommended Literature

- o Daft, R.L , Armstrong. A. . Organisation Theory and Design, Nelson Education, 2014
- o Laudon K. C., Laudon J.P.,: Management Information Systems: Managing the Digital Firm, 13th Edition, Pearson, 2014.
- o Schulz, O. Der SAP-Grundkurs für Einsteiger und Anwender, 2. Auflage, Galileo Press, 2013
- o Eversheim, W., Organisation in der Produktionstechnik, Arbeitsvorbereitung, VDI Verlag, Düsseldorf
- o Laux, H., Liermann, F.: Grundlagen der Organisation. Springer, 6. Aufl. Berlin 2005

## IE-ELECTIVE PROCESS ENGINEERING

Module code	IE-Elective
Module coordination	Prof. Markus Hainthaler
Course number and name	Process Engineering
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Qualification Goals

Within this course, students acquire the ability to understand the working principle of the most common production processes. Additionally, they are able to critically analyze various approaches how to produce a product by mechanical, thermal, chemical or biotechnological means, and judge their individual efficiency. This creates the basis for the reliable design and operation of any production system the students are concerned in their future engineer's life.

#### Professional and methodological Competences

##### *Knowledge*

After being taught the broad fundamentals of Energy Systems Engineering, this elective module in the higher semesters deepens the education for those students seeking for specialization in the design, operation and optimization of production processes. This module will cover the most important unit operations and plant equipment in mechanical, thermal, chemical and biological process engineering. All these topics are practiced with real-life problems in a broad variety of production systems and applications.

##### *Skills*



After completing this module, the students will be able to assist specialists in creating the appropriate educt-to-product process for a given production problem. As they understand both the different unit operations and the respective industrial equipment, they can evaluate the advantages and disadvantages of alternative methods for reaching the same goal with maximum efficiency. Furthermore, they can analyse an existing process regarding its productivity, both communicate and visualize the function of apparatuses and transfer results towards new applications.

### **Personal and social Competences**

The solution of the tasks given both in the lecture and the exam requires students' self-responsible and self-directed working style. Herein, the concepts of all module topics have to be applied to new problems, analyzed regarding their relevance, and evaluated in order to yield a reliable result.

## **Applicability in this Program**

IE-37 Bachelor Module

## **Applicability in this and other Programs**

This module is an elective lecture in the last semester of studies, so there will be no direct applicability within the same study programme. However, the learning outcomes can be applied in any other study programmes that deal with the design, operation, maintenance and optimization of plants and production systems.

## **Entrance Requirements**

Successful completion of the following modules is recommended:

Analytical Principles of Engineering (IE-01), Mathematics for Engineering (IE-08), Physics (IE-11), Chemistry (IE-03), Technical Mechanics II (IE-22), Plant Engineering (IE-29), Energy Technology (IE-23), Renewable Energies (IE-31)

## **Learning Content**

### **Mechanical Process Engineering**

- o Particle characterization: intrinsic / extrinsic properties, sphericity
- o Particle size distributions: cumulative fraction curve, size frequency curve
- o Mechanical separation: fraction balance curves, grade efficiency, sharpness of separation, industrial-scale equipment
- o Mechanical comminution: transition of particle size distributions, fracture mechanics, energy utilization, industrial-scale equipment
- o Mechanical mixing: degree of mixing, industrial-scale equipment

- o Scale-up: dimensionless characterization, power curve

### **Thermal Process Engineering**

- o Evaporation / condensation: T-H diagram, p-H diagram, stages of boiling, industrial-scale equipment
- o Distillation: zeotropic / azeotropic mixtures, partial pressures, partial evaporation and condensation, rectification, McCabe-Thiele method, industrial-scale equipment

### **Chemical Process Engineering**

- o Rate of reaction, fundamental mole balances
- o Ideal reactor types: batch reactor, plug flow reactor, continuous stirred tank reactor, packed bed reactor, design equations, conversion kinetics, sizing
- o Rate laws: power law, elementary / reversible / endothermic / exothermic reactions, reaction rate constant, Arrhenius law
- o Catalytic reactions: types of catalysts, rate-limiting steps, diffusion, deactivation
- o Multiple reactions: series / parallel reactions, selectivity

### **Biological Process Engineering**

- o Biological diversity: cell types, reproduction, nutrients, metabolic pathways, energy conversion
- o Enzymes: characterization, co-factors, immobilization, enzyme kinetics (Michaelis-Menten, allosteric, inhibited, competitive, uncompetitive)
- o Growth kinetics: yield, batch growth, aerobic / anaerobic growth, chemostat / turbidostat

## **Teaching Methods**

The lecture focuses on seminaristic teaching, but also applies detailed practical exercises based on the theoretical background. The key content is denoted in a written script via visualizer, while the supplemental content is conveyed via slide and video presentations. All material is uploaded to an online learning portal (iLearn). The students are strongly invited to discuss real-life problems and applications interactively throughout the lecture. Tutorials will be offered on demand.

## **Remarks**

Although the lecture is taught in English, some selected German literature is used to supplement the teaching content. In order to substantiate the lessons learnt, it is planned to offer an excursion to an industrial production site.

## Recommended Literature

- o R. Sinnott, G. Towler "Chemical Engineering Design", Butterworth-Heinemann, 5th edition 2009
- o R. Chhabra, V. Shankar "Coulson and Richardson ´s Chemical Engineering Vol. 1A: Fluid Flow - Fundamentals and Applications", Butterworth-Heinemann, 7th edition 2018
- o J.M. Coulson, J.F. Richardson "Coulson and Richardson ´s Chemical Engineering Vol. 2: Particle Technology and Separation Processes", Butterworth-Heinemann, 5th edition 2002
- o M. Stieß "Mechanische Verfahrenstechnik 1", Springer, 3rd edition 2009
- o M. Stieß "Mechanische Verfahrenstechnik 2", Springer, 1st edition 1997
- o H.S. Fogler "Essentials of Chemical Reaction Engineering", Prentice Hall, 2nd edition 2018
- o M.L. Shuler, F. Kargi, M. de Lisa "Bioprocess Engineering - Basic Concepts", Prentice Hall, 3rd edition 2017
- o A.B. de Haan "Process Technology - An Introduction", De Gruyter, 1st edition 2015
- o C.J. Geankoplis, A.A. Hersel, D.H. Lepek "Transport Processes and Separation Process Principles", Prentice Hall, 5th edition 2018

## IE-ELECTIVE PROCESS OPTIMIZATION

Module code	IE-Elective
Module coordination	Prof. Markus Hainthaler
Course number and name	Process Optimization
Lecturers	Prof. Markus Hainthaler Prof. Dr. Tobias Bader
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course
Level	undergraduate
Semester periods per week (SWS)	4
ECTS	5
Workload	Time of attendance: 60 hours self-study: 90 hours Total: 150 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weighting of the grade	5/210
Language of Instruction	English

### Module Objective

#### Qualification Goals

Within this course, students acquire the ability to understand the most common quality assurance and optimization methods throughout the whole life cycle of a plant, be it the responsible employment of investments, plant equipment or energy use. Additionally, they are able to critically analyze the status quo of a plant and develop individual approaches to improve it. This creates the basis for the reliable and sustainable design and operation of any production system the students are concerned in their future engineer's life.

#### Professional and methodological Competences

##### *Knowledge*

From the diversity of engineering courses in the previous semesters, the students are already capable of analyzing and designing a wide variety of sub-units of any production facility. Within this module, these competences are developed further towards the holistic optimization of these production processes, herein targeting at both quality improvement and energy minimization. A multitude of improvement tools

is presented which can be applied in all stages of designing, operating and debottlenecking a plant.

### *Skills*

After completing this module, the students will be able to discuss with specialists both from the engineering and economy department about optimization in all areas of a plant's performance. They understand the advantages and disadvantages of different optimization tools, their applicability limits and the required effort to realize them.

### **Personal and social Competences**

The solution of the tasks given both in the lecture and the exam requires students' self-responsible and self-directed working style. Herein, the concepts of all module topics have to be applied to new problems, analyzed regarding their relevance, and evaluated in order to yield a reliable result.

## **Applicability in this Program**

IE-37 Bachelor Module

## **Applicability in this and other Programs**

This module is an elective lecture designed for higher semester students, so there will be no direct applicability within the same study programme. However, the learning outcomes can be applied in any other study programmes that deal with the design, operation, maintenance and optimization of plants and production systems.

## **Entrance Requirements**

Successful completion of the following modules is recommended:

Plant Engineering (IE-29), Energy Technology (IE-23), Renewable Energies (IE-31), Sustainability (IE-17), Management (IE-30)

## **Learning Content**

### **Quality Engineering**

- o Process-oriented quality management
- o ISO 9000 ff.
- o Set-up and introduction of a quality management system
- o Methods and tools of quality planning
- o Total Quality Management
- o Six Sigma Process

- o Define, Measure, Analyze, Improve, and Control (DMAIC-framework)
- o Statistical methods within the DMAIC-framework

### **Production Optimization**

- o Reliability, Fault Tree Analysis
- o Process Integration: Process Design, Global Optimality, Heat Exchanger Networks (Pinch Method)
- o Sustainable Engineering: Aqueous Contamination, Atmospheric Emissions, Life Cycle Analysis (LCA)

## **Teaching Methods**

The lecture focuses on seminaristic teaching, but also applies detailed practical exercises based on the theoretical background. The key content is conveyed in combination of a written script and slide and video presentations. All material is uploaded to an online learning portal (iLearn). The students are strongly invited to discuss real-life problems and applications interactively throughout the lecture. Tutorials will be offered on demand.

## **Recommended Literature**

### **Quality Engineering**

- o T. Pyzdek "Quality Engineering Handbook", CRC Press
- o G. Linß "Qualitätsmanagement für Ingenieure", Hanser, München-Wien
- o Pfeifer "Praxisbuch Qualitätsmanagement", Hanser, München-Wien

### **Production Optimization**

- o B. Bertsche "Reliability in Automotive and Mechanical Engineering", 1st edition
- o R. Smith "Chemical Process Design and Integration", 2nd edition