



# **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
Lecturer	Ibrahim Bader
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.
Weight	
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

After successfully finishing the module, students will get to:

- o understand basic mathematical concepts and know how to apply standard mathematical methods.
- o visualize mathematical objects and interpret mathematical symbols and formulas.
- o acquire feeling for handling numbers and functions.
- o solve problems on their own and verify the solutions.
- o apply numerical and graphical solution methods to various tasks.
- o enhance problem solving skills.
- o simple application of standard procedures.

##### Skills

Upon completion of the module the students will be able to:



- o evaluate and perform vectors operations.
- o perform matrix operations.
- o solve systems of linear equations using various methods.
- o manipulate complex numbers.
- o determine convergence or divergence of a given series or sequence.
- o obtain numerical solutions to some problems in important engineering subject areas.
- o visualize mathematical objects and to interpret mathematical symbols and formulas.
- o apply numerical and graphical solution methods to various tasks.

### **Social competence**

- o Students are demonstrating working in small groups to solve problems that aims at enhancing their team-working skills as well as their problem solving capabilities. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

## **Applicability in this Program**

IE-07 Mathematics for Engineering

IE-09 Technical Mechanics II

IE-14 Applied Mathematics

IE-16 Energy Technology

IE-18 Chemistry

IE-23 Plant Engineering

IE-Elective Process Engineering

## **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**

Knowledge of high school mathematics



## 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

Lectures / exercises / tutorials / home work / group activities

Whiteboard, visualizer online learning portal (iLearn), weekly exercise session using active learning.

## 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
Lecturer	Prof. Dr. Sascha Kreiskott
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.
Weight	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 TECHNICAL MECHANICS I

Module code	IE-03
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Technical Mechanics I
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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	oral ex. 30 min.
Weight	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 Program**

IE-09 Technical Mechanics II

## **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 7th 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-04 ACCOUNTING

Module code	IE-04
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Accounting
Lecturer	Prof. Dr. Robert Feicht
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.
Weight	
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

Students develop a thorough understanding of basic accounting principles and practice related to accounting concepts, systems and procedures.

#### Knowledge

- o Students 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 fully understand the operational functions of financial accounting and the informational expectations on financial accounting. For this they are able to take the perspectives of all main stakeholders of a business.
- o Students have a deep understanding of financial reports as a basic skill for business studies.
- o Students know and understand the differences and linkages between the three main financial reporting statements.

#### Skills



- o Students are able to evaluate the impact of business transactions on financial accounting. In particular, students have a deep understanding of the effectiveness/neutrality of business transactions on financial statements.
- o Within the scope of double-entry bookkeeping students execute accounting transactions independently.
- o Students are able to prepare and read financial statements and management reports. They analyze these statements within the context of decision making.
- o By performing financial statement analyses students are able to assess the financial situation (profitability and financial risk) of a company applying the understanding gained before.

### **Personal competence**

#### *Social competence*

- o Students develop communication skills that are supported by tasks and case studies. They are familiar with the essential terminology of financial accounting and communicate about basic problems with other participants using the appropriate technical terms.
- 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.
- o Students are able to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.

#### *Autonomy*

- o Students will be able to solve complex problems independently with application-related, fundamental knowledge of bookkeeping and accounting.
- o Students are able to relate their acquired knowledge to other lectures and topics.

### **Applicability in this Program**

IE-10 Business Law

IE-20 Financing

### **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"; 17th internat. edition; New York: McGraw-Hill Education; 2015.

### Supplementary literature

Dyson J.R., Franklin E.; "Accounting for Non-Accounting Students"; 9th edition; Harlow: Pearson Education; 2017.

McLaney E., Atrill P.; "Accounting and Finance: An Introduction"; 9th edition; Harlow: Pearson Education; 2018.



## IE-05 PRINCIPLES IN BUSINESS

Module code	IE-05
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Principles in Business
Lecturer	Prof. Dr. Robert Feicht
Semester	1
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	6
ECTS	6
Workload	Time of attendance: 90 hours self-study: 135 hours Total: 225 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

Students will develop a thorough understanding of business and economic processes and interdependencies.

#### *Knowledge*

- o With a view to the practice, students understand and structure planning processes, decision-making processes and control processes in companies.
- o Students know and understand the development of central management approaches. They know the basic instruments in the management process.
- o Students have a basic understanding of microeconomic and macroeconomic analysis.

#### *Skills*

- o Students are able to describe the operational functions systematically and explain interdependencies in a differentiated way.
- o Students are able to recognize the interdependencies of markets and companies and derive economic policy recommendations from them.





- o With a view to current discussions, students can use economic models and apply them to corresponding questions. They can create basic economic analyses of a company's market environment and show their consequences for a single firm.

### **Personal competence**

#### *Social competence*

- o Students develop communication skills that are supported by tasks and case studies. They 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.
- o Students are able to work problem/solution-oriented in small mixed groups, learning and broadening teamwork abilities.

#### *Autonomy*

- o Students understand the interplay between economic regulations, institutional framework and strategic profile of a company and derive their own opinions.
- o Students can handle tough work and study contexts independently and design them in an application-oriented way.
- o Students are able to handle complex economic issues graphically, arithmetically and verbally.
- o Students are able to relate their acquired knowledge to other lectures and topics.

### **Applicability in this Program**

IE-10 Business Law

IE-20 Financing

IE-21 Logistics and Operations Research

IE-31 Management

IE-Elective Business Planning and Start-Up Management

IE-Elective Energy Markets

IE-Elective Energy and Resource Efficiency

IE-Elective Globalisation

IE-Elective Modelling Theory

IE-Elective Operational Processes



## 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"; 6th edition; Boston, MA: Cengage Learning; 2018.

Mankiw N.G.; "Essentials of Economics"; 8th edition; Boston, MA: Cengage Learning; 2018.

### Supplementary literature

Ebert R.J., Griffin R.W.; "Business Essentials"; 11th global edition; Boston: Pearson Education; 2017.

Nickels W.G., McHugh J.M., McHugh S.M.; "Understanding Business"; 11th. internat. edition; New York: McGraw-Hill Education; 2016.



## IE-06 FOREIGN LANGUAGE I

Module code	IE-06
Module coordination	Tanja Mertadana
Course number and name	Foreign Language 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	4
Workload	Time of attendance: 60 hours self-study: 60 hours Total: 120 hours
Type of Examination	written ex. 90 min.
Duration of Examination	90 min.
Weight	
Language of Instruction	English

### Module Objective

The modules Foreign Language I and III aim 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 English language in business and technical settings so that they can effectively and efficiently implement the language as a practical communication tool.

To this end, the module targets instruction of the four cardinal language skills (listening, reading, speaking, and writing) across a wide range of core business and technical topics related to industrial engineering. Students also craft the content of their own learning through needs analyses and frequent immersive and self-directed projects.

Central to the module is optimizing fluency and communication skills; so too is cultivating a clear understanding of the finer points of textual meaning and meaning produced in dialogue with others. Through a variety of task-based speaking, listening and writing activities, students enhance their oral and aural production and expand their ability to produce clear, concise and coherent pieces of writing – emails, reports, or expository paragraphs on business and technical processes. Particular emphasis will be placed on honing students' public speaking and team skills through work on a team presentation project for each course.

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



### Professional competencies

- o Students will have an independent command of specialized business and technical terminology relevant to the field of industrial engineering. Command here refers to oral and written production as well as aural and reading comprehension.
- o They will be in a position to deploy study skills such as close reading and coherent writing at a B2/C1-level and for use in niche tasks for the industrial engineering sector.
- o They will have gained substantial knowledge of B2/C1-level language registers – both for formal study contexts and for semi-formal to formal professional contexts.
- o They will have gained essential experience in presenting on topics related to business and technical English. The goal here is to package niche knowledge in the protocols of a clearly structured, effectively delivered piece of public speaking.

### Methodological competencies

- o Students will have enhanced their abilities to structure the acquisition of specialized terminology and grammatical items and practiced ways to internalize new language that yield optimal learning benefits.
- o They will have extended and refined their practical research skills in English by engaging in at least two research projects – for example, by being asked to present on a discipline-specific topic in an individual or team presentation.

### Social competencies

- o Students will have gained valuable experience in training other personal effectiveness skills such as team work, integrity, and reliability.
- o They will have reflected on the learning benefits derived from several immersion projects.

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

The module can also be chosen by students of other fields of study.

## **Entrance Requirements**

The minimum entry-level requirement is a B2-level of English according to the Common European Framework of Reference for Languages (CEFR) or A-level language skills according to the standards of the German education system. Alternatively, experience living abroad or successful participation in a study exchange may be sufficient.

## **Learning Content**



## General Business English

- o business basics
- o company structures
- o markets and market structures
- o business startups
- o launching a product
- o innovation and technology in business
- o online business
- o marketing
- o communication and business correspondence
- o business meetings and presentations
- o working across cultures
- o current business topics

## Teaching Methods

Instruction and learning methods focus on training the four cardinal language skills (speaking, listening, reading, and writing) and on enhancing professional and social competencies. They include group discussions and group projects, individual and team work (e.g. individual and group presentations), real- and role-playing, close reading and listening activities, grammar games, method of loci, running dictations, translations, peer feedback and review, work with learning stations, and various follow-up viewing and writing activities.

Study assignments will be set on a weekly basis.

## Recommended Literature

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

Business Spotlight: <[www.business-spotlight.de](http://www.business-spotlight.de)>

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.

Doyle, Charles. *A Dictionary of Marketing*. 4th ed. Oxford: OUP, 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.

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.



## IE-07 MATHEMATICS FOR ENGINEERING

Module code	IE-07
Module coordination	Ibrahim Bader
Course number and name	Mathematics for Engineering
Lecturer	Ibrahim Bader
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.
Weight	5 / 210
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

After successfully finishing the module, students will get:

- o awareness of the basic concepts of theoretical mathematics and calculus.
- o ability to apply mathematical skills for solving real life engineering problems.
- o broad knowledge and basic understanding of the topics related to Elementary functions, Partial differentiation and Ordinary differential equations.
- o understand and apply the Fundamental Theorem of Calculus.
- o be aware about using mathematical modelling in applied field of engineering and business.
- o enhance problem solving and team work skills.

##### Skills

Upon completion of the module the students will be able to:





- o evaluate limits of basic functions.
- o understand the concept of continuous functions.
- o differentiate functions of one or more variables.
- o solve first order ordinary differential equations.
- o manipulate partial derivatives.
- o manipulate infinite and finite Integrals.
- o obtain numerical solutions to some engineering and real life problems using differential and integral methods.
- o expand periodic functions using Fourier-Series.

### **Personal competence**

#### Social competence

- o Students are demonstrating working in small groups to solve problems that aims at enhancing their team-working and logical problem solving skills. Further, these groups are lined-up in a way to be mixed multi-cultural in order to foster and fine-tune students' intercultural interaction capabilities.

## **Applicability in this Program**

IE-14 Applied Mathematics

IE-16 Energy Technology

IE-23 Plant Engineering

IE-Elective Process Engineering

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

Mathematics is essential for most of engineering and scientific courses. This module, together with Applied Mathematics (IE-14), lay the foundation on which most of the engineering and other scientific modules for the rest of the study program will be built.

## **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

## Teaching Methods

Lectures / exercises / tutorials / home work / group activities

Whiteboard, visualizer online learning portal (iLearn), weekly exercise session using active learning methods.

## 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-08 INFORMATICS FOR ENGINEERING II

Module code	IE-08
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Informatics for Engineering II
Lecturer	Prof. Dr. Sascha Kreiskott
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	report/presentation
Weight	5/210
Language of Instruction	English

### Module Objective

#### Professional Competence

##### Knowledge

- o Know and understand the basic principles, commands and syntax of Visual Basic.
- o Know and understand the structure of computer programs.
- o Know and understand how to write a program in computer code.

##### Skills

- 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 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 visual basic.
- 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 Program**

IE-27 Applied Measurement and Control Engineering

IE-Elective Data Acquisition and Processing

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

All similar study programs.

### **Entrance Requirements**

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

### **Learning Content**

- o Visual Basic projects
- o Program structure
- o Variable types
- o Computer languages
- o Syntax
- o Software development process
- o Mathematical library
- o Case selection and decision
- o Loops
- o Arrays
- o Subroutines



- o Functions
- o Computer graphics
- o Colour

## 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

Visual Basic (Microsoft Visual Studio 2017) will be the main language used in this class.

## Recommended Literature

<https://docs.microsoft.com/de-de/dotnet/visual-basic/getting-started/>



## IE-09 TECHNICAL MECHANICS II

Module code	IE-09
Module coordination	Prof. Markus Hainthaler
Course number and name	Technical Mechanics II
Lecturers	Prof. Dr. Thorsten Gerdes Prof. Markus Hainthaler
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.
Weight	5/210
Language of Instruction	English

### Module Objective

#### Professional and methodological competences:

##### *Knowledge*

From IE-03 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-22 Renewable Energies

IE-23 Plant Engineering

IE-30 Sustainability

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:

IE-01 Analytical Principles of Engineering, IE-03 Technical Mechanics I

**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-10 BUSINESS LAW

Module code	IE-10
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Business Law
Lecturer	Tobias Appel
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.
Weight	
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 Program**

IE-20 Financing

IE-21 Logistics and Operations Research

IE-31 Management

### **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"; 15th edition; München: C.H. Beck; 2017.  
Dietl C.E., Lorenz E.; "Wörterbuch Recht, Wirtschaft & Politik = Dictionary of Legal, Commercial and Political Terms, Band/Volume 2"; 6th edition; München: C.H. Beck; 2019.



### **Taxation**

Jochum H., Thiele P.J.; "Introduction to German Tax Law"; 2nd edition; Stuttgart: Boorberg; 2018.

Dommermuth T., Herrler H., Hottmann J., Huber-Jahn I., Schmidt C., Weggenmann H.R.; "Ertragsteuern (Betriebliche Steuern)"; 2nd edition; Stuttgart: Schäffer-Poeschel; 2006.

Zenthöfer W., Alber M.; "Körperschaftsteuer und Gewerbesteuer (Grundkurs des Steuerrechts)"; 18th edition; Stuttgart: Schäffer-Poeschel; 2019.

Woywode U.; "Wörterbuch Rechnungslegung und Steuern. Accounting and Tax Dictionary"; 1st edition; Willingshausen: e-Lex; 2000.



## IE-11 PHYSICS

Module code	IE-11
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Physics Lab Work in Physics
Lecturer	Prof. Dr. Sascha Kreiskott
Semester	2
Duration of the module	1 semester
Module frequency	annually
Course type	compulsory course, required course
Level	Undergraduate
Semester periods per week (SWS)	6
ECTS	6
Workload	Time of attendance: 90 hours self-study: 60 hours Total: 150 hours
Weight	6/210
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 Program

IE-09 Technical Mechanics II

IE-16 Energy Technology

IE-23 Plant Engineering

IE-Elective Energy and Resource Efficiency

IE-Elective Process Engineering

## 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.

## ▶ PHYSICS

### Objectives

Workload:

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

### Type of Examination

written ex. 90 min.

## ▶ LAB WORK IN PHYSICS

### Objectives

Workload:

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

### Type of Examination

report/presentation



## IE-12 FOREIGN LANGUAGE II

Module code	IE-12
Module coordination	Tanja Mertadana
Course number and name	Foreign Language II
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.
Weight	
Language of Instruction	English

### Module Objective

The modules Foreign Language II and IV aim to equip students with specialized language skills necessary for independent performance in a globalized industrial engineering sector. As a specialty the students can either choose an English course or vote between other languages such as Italian, Spanish or French.

#### Business English: Writing and communication skills

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

Professional competencies

- o Students will have an independent command of specialized business terminology relevant to the field of industrial engineering. Command here refers to oral and written production as well as aural and reading comprehension.
- o They will be in a position to deploy study skills such as close reading and coherent writing at a B2/C1-level and for use in niche tasks for the industrial engineering sector.
- o They will have gained substantial knowledge of B2/C1-level language registers – both for formal study contexts and for semi-formal to formal professional contexts.



- o They will have gained essential experience in presenting on topics related to business English. The goal here is to package niche knowledge in the protocols of a clearly structured, effectively delivered piece of public speaking.

#### Methodological competencies

- o Students will have enhanced their abilities to structure the acquisition of specialized terminology and grammatical items and practiced ways to internalize new language that yield optimal learning benefits.
- o They will have extended and refined their practical research skills in English by engaging in at least two research projects – for example, by being asked to present on a discipline-specific topic in an individual or team presentation.

#### Social competencies

- o Students will have gained valuable experience in training other personal effectiveness skills such as team work, integrity, and reliability.
- o They will have reflected on the learning benefits derived from several immersion projects

#### **Other language course**

Please see the respective course descriptions.

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

The module can also be chosen by students of other fields of study.

### **Entrance Requirements**

English course: The minimum entry-level requirement is a B2/C1-level of English according to the Common European Framework of Reference for Languages (CEFR) or A-level language skills according to the standards of the German education system. Alternatively, experience living abroad or successful participation in a study exchange may be sufficient.

Other language: Please see the respective course descriptions.

### **Learning Content**

#### **Business English: Writing and communication skills**

Writing and communication skills in business, including a review and consolidation of the business topics dealt with in Foreign Language I (General Business English).

- o review and consolidation of FL I topics
- o job satisfaction



- o success in business
- o business correspondence
- o meetings, negotiations and presentations
- o international marketing
- o working across cultures
- o current business topic

## Teaching Methods

Instruction and learning methods focus on training the four cardinal language skills (speaking, listening, reading, and writing) and on enhancing professional and social competencies. They include group discussions and group projects, individual and team work (e.g. individual and group presentations), real- and role-playing, close reading and listening activities, grammar games, method of loci, running dictations, translations, peer feedback and review, work with learning stations, and various follow-up viewing and writing activities.

Study assignments will be set on a weekly basis.

## Recommended Literature

Recommended reading for Business English: Writing and communication skills

Black, John, Hashimzade, Nigar & Myles, Gareth. *A Dictionary of Economics*.

5th ed. Oxford: OUP, 2017.

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

CUP, 2013.

Business Spotlight: <[www.business-spotlight.de](http://www.business-spotlight.de)>

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.

Doyle, Charles. *A Dictionary of Marketing*. 4th ed. Oxford: OUP, 2016.

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

2008.



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

McCarthy, Michael & O'Dell, Felicity. *Academic Vocabulary in Use*. Cambridge: CUP, 2016.

Murphy, Raymond. *English Grammar in Use*. Klett Verlag, 2012.

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

Recommended reading for other language

Please see the respective course descriptions for literature references.



## IE-13 COMPULSORY ELECTIVE SUBJECTS OF A GENERAL ACADEMIC NATURE (AWP) I

Module code	IE-13
Module coordination	Tanja Mertadana
Course number and name	AWP I
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 student research project, written ex. 60 min.
Duration of Examination	60 min.
Weight	
Language of Instruction	English

### Module Objective

The AWP subjects provide the students with the opportunity to gain knowledge and skills in other fields than their chosen field of study. Students can choose both instructor-led inhouse courses and courses of the Virtual University of Bavaria (vhb).

The contents of the courses cover the following areas:

- o Languages
- o Didactical-educational area
- o Social sciences
- o Psychological-sociological area
- o Technical-scientific area
- o Philosophical and socio-ethical area
- o Business area

The students can choose their courses from the AWP-module according to their own preferences.



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

The module can also be chosen by students of other fields of study.

## **Entrance Requirements**

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

AWP subjects may not have thematic overlaps with the actual study course.

## **Learning Content**

Please see the respective course descriptions for specific information on contents.

## **Teaching Methods**

Seminar / exercises / class presentations / classroom pair/group work

## **Remarks**

Please see the respective course descriptions for course-specific remarks.

## **Recommended Literature**

Please see the respective course descriptions for literature references.



## IE-14 APPLIED MATHEMATICS

Module code	IE-14
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Applied Mathematics
Lecturer	Prof. Dr. Robert Feicht
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.
Weight	
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

Based on the learning outcomes of Analytical Principles of Engineering (IE-01) and Mathematics for Engineering (IE-07), in this module students will develop an intuition for numbers, data and dimensions.

#### Knowledge

- o Students know and understand different statistical methods based on their capability, assumptions, and limitations and select suitable methods appropriate to specific (research) problems.
- o Students are familiar with the methodological foundations of empirical surveys and can apply them, for example, to empirical project work.

#### Skills

- o From unstructured data students are able to gain relevant business and economic information and insights with the help of appropriate structuring, consolidation, graphical processing, and calculation of parameters.
- o The corresponding analyses are made both manually and with the help of appropriate software packages.





- o Students can critically interpret own and existing statistics from internal or external sources.

### **Personal competence**

#### *Social competence*

- o Small work groups are defined to solve (research) problems and case studies. Close cooperation deepens student's social competences and fosters a team-oriented working style.
- o Students can explain and defend their results in front of the class. They are able to explain their assessment of alternative courses of action and impugn the plausibility of using models. This interactive character of the lectures and tutorials strengthens the student's discussion and presentation skills in the academic context.

#### *Autonomy*

- o Students can self-responsibly deal with unstructured data and select appropriate statistical models.
- o Students are able to carry out their own empirical project work and derive recommended actions for the client.
- 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 Program**

IE-20 Financing

IE-21 Logistics and Operations Research

IE-Elective Modelling Theory

## **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"; 3rd global edition; Harlow: Pearson Education; 2015.

Levine D.M., Stephan D.F., Szabat K.A.; "Statistics for Managers Using Microsoft Excel"; 8th global edition; Harlow: Pearson Education; 2017.

### Supplementary literature

Groebner D.F., Shannon P.W., Fry P.C.; "Business Statistics"; 10th global edition; Harlow: Pearson Education; 2018.

Barrow M.; "Statistics for Economics, Accounting and Business Studies"; 7th edition; Harlow: Pearson Education; 2017.



## 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
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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	oral ex. 30 min.
Weight	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 Analysing and building simple circuits on experimental boards
- 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 Program**

IE-23 Plant Engineering

IE-26 Fundamentals of Measurement and Control Engineering

IE-27 Applied Measurement and Control Engineering

IE-Elective Industrial Automation and Information Technology

## **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 ENERGY TECHNOLOGY

Module code	IE-16
Module coordination	Prof. Dr. Rui Li
Course number and name	Energy Technology
Lecturer	Prof. Dr. Rui Li
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.
Weight	5/210
Language of Instruction	English

### Module Objective

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 Program**

IE-22 Renewable Energies

IE-23 Plant Engineering

IE-30 Sustainability

IE-32 Project Work

IE-Elective Energy Markets

IE-Elective Energy and Resource Efficiency

IE-Elective Process Engineering





## 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 / home work

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-17 SCIENTIFIC WRITING, RESEARCH METHODS AND PROJECT MANAGEMENT

Module code	IE-17
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Scientific Writing, Research Methods and Project Management
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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	report/presentation
Weight	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 Program**

IE-27 Applied Measurement and Control Engineering

IE-32 Project Work

IE-37 Bachelor Module

## **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-18 CHEMISTRY

Module code	IE-18
Module coordination	Prof. Dr. Raimund Brotsack
Course number and name	Chemistry Lab Work in Chemistry
Lecturer	Prof. Dr. Raimund Brotsack
Semester	3
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	undergraduate
Semester periods per week (SWS)	6
ECTS	6
Workload	Time of attendance: 90 hours self-study: 90 hours Total: 180 hours
Weight	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-22 Renewable Energies

IE-23 Plant Engineering

IE-30 Sustainability

IE-32 Project Work

IE-Elective Process Engineering

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

D-1105 Chemie, BA Maschinenbau at THD

E-1101 Chemie, BA Bauingenieurwesen at THD

Y-1101 Chemie, BA Umweltingenieurwesen 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**

written ex. 90 min.

### **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

### **Type of Examination**

report/presentation



## IE-19 FOREIGN LANGUAGE III

Module code	IE-19
Module coordination	Tanja Mertadana
Course number and name	Foreign Language III
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	written ex. 90 min.
Duration of Examination	90 min.
Weight	
Language of Instruction	English

### Module Objective

The modules Foreign Language I and III aim 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 English language in business and technical settings so that they can effectively and efficiently implement the language as a practical communication tool.

To this end, the module targets instruction of the four cardinal language skills (listening, reading, speaking, and writing) across a wide range of core business and technical topics related to industrial engineering. Students also craft the content of their own learning through needs analyses and frequent immersive and self-directed projects.

Central to the module is optimizing fluency and communication skills; so too is cultivating a clear understanding of the finer points of textual meaning and meaning produced in dialogue with others. Through a variety of task-based speaking, listening and writing activities, students enhance their oral and aural production and expand their ability to produce clear, concise and coherent pieces of writing – emails, reports, or expository paragraphs on business and technical processes. Particular emphasis will be placed on honing students' public speaking and team skills through work on a team presentation project for each course.

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



#### Professional competencies

- o Students will have an independent command of specialized business and technical terminology relevant to the field of industrial engineering. Command here refers to oral and written production as well as aural and reading comprehension.
- o They will be in a position to deploy study skills such as close reading and coherent writing at a C1-level and for use in niche tasks for the industrial engineering sector.
- o They will have gained substantial knowledge of C1-level language registers – both for formal study contexts and for semi-formal to formal professional contexts.
- o They will have gained essential experience in presenting on topics related to business and technical English. The goal here is to package niche knowledge in the protocols of a clearly structured, effectively delivered piece of public speaking.

#### Methodological competencies

- o Students will have enhanced their abilities to structure the acquisition of specialized terminology and grammatical items and practiced ways to internalize new language that yield optimal learning benefits.
- o They will have extended and refined their practical research skills in English by engaging in at least two research projects – for example, by being asked to present on a discipline-specific topic in an individual or team presentation.

#### Social competencies

- o Students will have gained valuable experience in training other personal effectiveness skills such as team work, integrity, and reliability.
- o They will have reflected on the learning benefits derived from several immersion projects.

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

The module can also be chosen by students of other fields of study.

### **Entrance Requirements**

The minimum entry-level requirement is B2/C1-level of English according to the Common European Framework of Reference for Languages (CEFR) or A-level language skills according to the standards of the German education system. Alternatively, experience living abroad or successful participation in a study exchange may be sufficient.

### **Learning Content**



## Technical English (C1)

Course content is divided across a set of mandatory topics that the lecturer chooses and non-mandatory topics that students elect to work on.

Mandatory topics include, but are not restricted to the following:

- o Mathematical operations and numbers
- o Measurements and units
- o Geometric forms
- o Fundamentals of physics (e.g. forces)
- o Materials and their properties
- o Case study on an area related to technology/design/engineering
- o Communication skills (e.g. presentations)
- o Grammar items (e.g. passive vs active, tenses, conditionals)

Examples of non-mandatory topics include the following:

- o Renewable energy
- o E-mobility
- o Basic electrical engineering
- o Computing
- o Geo-information systems
- o Work safety

## Teaching Methods

Instruction and learning methods focus on training the four cardinal language skills (speaking, listening, reading, and writing) and on enhancing professional and social competencies. They include group discussions and group projects, individual and team work (e.g. individual and group presentations), real- and role-playing, close reading and listening activities, grammar games, method of loci, running dictations, translations, peer feedback and review, work with learning stations, and various follow-up viewing and writing activities.

Study assignments will be set on a weekly basis.

## Recommended Literature

Astley, Peter, and Lewis Lansford. *Engineering 1: Student's Book*. Oxford: Oxford



UP, 2013. Print.

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

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

Büchel, Wolfram, et. al. *Englisch-Grundkurs für technische Berufe*. Stuttgart:  
Klett, 2001. Print.

engine: Englisch für Ingenieure. Darmstadt. <[www.engine-magazin.de](http://www.engine-magazin.de)>

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

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

Glendinning, Eric H. and Norman. *Oxford English for Electrical and Mechanical  
Engineering*. Oxford: OUP, 2001. Print.

Hollett, Vicki and John Sydes. *Tech Talk: Intermediate*. Oxford: OUP, 2010. Print.

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

Lansford, Lewis, and Peter Astley. *Engineering 1*. Oxford: Oxford UP, 2013. Print.

Möllerke, Georg. *Modern English for Mechanical Engineers*. Munich: Carl Hanser  
Verlag, 2010. Print.

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



## IE-20 FINANCING

Module code	IE-20
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Financing
Lecturer	Prof. Dr. Robert Feicht
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.
Weight	
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

Based on the knowledge of the module Accounting (IE-04), students can classify the functions of investment and financing into the operational sequences and understand their basic tasks, goals, and instruments.

#### Knowledge

- o Students know and understand central methodological foundations and instruments of investment and financing, can explain them and apply them to typical operational problems.
- 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.

#### Skills

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



- o In their professional practice, students can identify problem situations that require investment and financing solutions. They are able to independently find adequate solutions for these situations, to evaluate them and to question them critically.

### **Personal competence**

#### *Social competence*

- o Small work groups are defined to solve (research) problems and case studies. Close cooperation deepens student's social competences and fosters a team-oriented working style.
- 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 The interactive character of the lectures and tutorials strengthens the student's discussion skills in the academic context.

#### *Autonomy*

- o Students know and understand the limitations, assumptions and problems of methods and instruments of investment and financing in a specific context. Students can independently choose and employ suitable valuation approaches for the respective task.
- o A thorough understanding of asset pricing models will concurrently improve the student's ability to make smart financial decisions.
- o Students are able to relate their acquired knowledge to other lectures and topics.

### **Applicability in this Program**

IE-30 Sustainability

IE-31 Management

### **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"; 9th internat. edition; New York: McGraw-Hill Education; 2017.

Gitman L.J., Zutter C.J.; "Principles of Managerial Finance"; 14th global edition; Harlow: Pearson Education; 2015.

Brealey R.A., Myers S.C., Allen F.; "Principles of Corporate Finance"; 12th internat. edition; New York: McGraw-Hill Education; 2017.

### Supplementary literature

Berk J., DeMarzo P.; "Corporate Finance: The Core"; 4th global edition; Harlow: Pearson Education; 2017.

Brigham E.F., Houston J.F.; "Fundamentals of Financial Management"; 15th edition; Boston, MA: Cengage Learning; 2018.

Keown A.J., Martin J.D., Petty J.W.; "Foundations of Finance"; 9th global edition; Harlow: Pearson Education; 2017.



## IE-21 LOGISTICS AND OPERATIONS RESEARCH

Module code	IE-21
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Logistics and Operations Research
Lecturer	Prof. Dr. Robert Feicht
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.
Weight	
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

Based on the learning outcomes of Principles in Business (IE-05), after completing this module, students are familiar with the core concepts and requirements of operational management and the operational functions of procurement, production, distribution and logistics affected by supply chain management (SCM). Based on the learning outcomes of Analytical Principles of Engineering (IE-01), Mathematics for Engineering (IE-07), and Applied Mathematics (IE-14), in this module students will also expand and deepen their quantitative skills.

#### Knowledge

- o Students understand the concepts of integrative logistics and SCM as optimizing cross-departmental functions and practice process-oriented thinking.
- o The students are qualified to build up comprehensive and detailed mathematical models with a focus on linear optimization and graph theory.

#### Skills

- o Students are able to analyze 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) and solve them using powerful methods.

- o Students 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. Knowing the advantages and disadvantages of individual methods, students can assess the approaches' plausibility under different conditions.
- o Students are able to model a linear programming problem using spreadsheet software packages and their implemented Solver add-ins.

### **Personal competence**

#### *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 student's social competences and fosters a team-oriented working style.
- o The interactive character of the lectures and tutorials strengthens the student's discussion skills in the academic context.

#### *Autonomy*

- o In practice, 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 are able to relate their acquired knowledge to other lectures and topics.

### **Applicability in this Program**

IE-30 Sustainability

IE-31 Management

IE-32 Project Work

IE-Elective Modelling Theory

IE-Elective Operational Processes

### **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"; 13th internat. edition; New York: McGraw-Hill Education; 2018.*

*Jacobs F.R., Chase R.B.; "Operations and Supply Chain Management"; 15th internat. edition; New York: McGraw-Hill Education; 2018.*

*Coyle J.J., Langley C.J., Novack R.A., Gibson B.J.; "Supply Chain Management. A Logistics Perspective"; 10th edition; Boston, MA: Cengage Learning; 2017.*

*Chopra S.; "Supply Chain Management. Strategy, Planning, and Operation"; 7th global edition; Harlow: Pearson Education; 2019.*

### Operations Research

*Anderson D.R., Sweeney D.J., Williams T.A., Camm J.D., Cochran J.J.; "An Introduction to Management Science"; 14th edition; Boston, MA: Cengage Learning; 2016.*

*Ragsdale C.T.; "Spreadsheet Modeling and Decision Analysis"; 8th edition; Boston, MA: Cengage Learning; 2017.*

*Taylor B.W.; "Introduction to Management Science"; 12th global edition; Harlow: Pearson Education; 2016.*

*Lawrence J.A., Pasternack B.A.; "Applied Management Science. Modeling, Spreadsheet Analysis, and Communication for Decision Making"; 2nd edition; New York: Wiley; 2002.*



## IE-22 RENEWABLE ENERGIES

Module code	IE-22
Module coordination	Prof. Dr. Raimund Brotsack
Course number and name	IE-22 Renewable Energies
Lecturer	Prof. Dr. Raimund Brotsack
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.
Weight	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-30 Sustainability

IE-Elective Process Engineering

**Applicability in this and other Programs**

Y-09 Regenerative Energien 1, Bachelor Umweltingenieurwesen at THD

D-7106 Regenerative Energie- und Stofftechnik, Bachelor Maschinenbau 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

## 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: Power 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: Production, Conversion, Storage, Conservation, and Coupling



## IE-23 PLANT ENGINEERING

Module code	IE-23
Module coordination	Prof. Markus Hainthaler
Course number and name	Plant Engineering
Lecturer	Prof. Markus Hainthaler
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.
Weight	5/210
Language of Instruction	English

### Module Objective

#### 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 material balances, 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. The expertise of this module will create the basis for all subsequent lectures of Industrial Engineering which require a holistic view of plants - like Applied Measurement and Control Engineering (IE-27), Process Reliability (IE-28) and Sustainability (IE-30).

##### *Skills*

After completing this module, the students will be able to 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 profitability of the plant. Additionally, they are able to communicate and visualize the production systems by creating material balances and 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-27 Applied Measurement and Control Engineering
- IE-Elective Energy and Resource Efficiency
- IE-Elective Industrial Automation and Information Technology
- 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 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-07), Physics (IE-11), Chemistry (IE-18), Energy Technology (IE-16), Fundamentals of Electrical Engineering (IE-15), Technical Mechanics II (IE-09)

**Learning Content**

**Fluid Mechanics**

- o Fluid characterization: classes of fluids, rheology, surface tension, utilization of 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 Material balances: conservation of mass / volume / moles
- o Incomplete chemical conversion
- o Yield, process profitability
- 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
- o Production site considerations

### **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, 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 N. Ghasem, R. Henda "Principles of Chemical Engineering Processes - Material and Energy Balances", CRC Press, 2nd edition 2015
- 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-24 COMPULSORY ELECTIVE SUBJECTS OF A GENERAL ACADEMIC NATURE (AWP) II

Module code	IE-24
Module coordination	Tanja Mertadana
Course number and name	AWP II
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	written student research project, written ex. 60 min.
Duration of Examination	60 min.
Weight	
Language of Instruction	English

### Module Objective

The AWP subjects provide the students with the opportunity to gain knowledge and skills in other fields than their chosen field of study. Students can choose both instructor-led inhouse courses and courses of the Virtual University of Bavaria (vhb).

The contents of the courses cover the following areas:

- o Languages
- o Didactical-educational area
- o Social sciences
- o Psychological-sociological area
- o Technical-scientific area
- o Philosophical and socio-ethical area
- o Business area

The students can choose their courses from the AWP-module according to their own preferences.



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

The module can also be chosen by students of other fields of study.

## **Entrance Requirements**

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

AWP-subjects may not have thematic overlaps with the actual study course.

## **Learning Content**

Please see the respective course descriptions for specific information on contents.

## **Teaching Methods**

Seminar / exercises / class presentations / classroom pair/group work

## **Remarks**

Please see the respective course descriptions for course-specific remarks.

## **Recommended Literature**

Please see the respective course descriptions for literature references.



## IE-25 FOREIGN LANGUAGE IV

Module code	IE-25
Module coordination	Tanja Mertadana
Course number and name	Foreign Language IV
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	written ex. 60 min.
Duration of Examination	60 min.
Weight	
Language of Instruction	English

### Module Objective

The modules Foreign Language II and IV aim to equip students with specialized language skills necessary for independent performance in a globalized industrial engineering sector. As a specialty the students can either choose an English course or vote between other languages such as Italian, Spanish or French.

#### Presentation skills for technical purposes (C1)

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

Professional competencies

- o Students will have an independent command of specialized technical terminology relevant to the field of industrial engineering. Command here refers to oral and written production as well as aural and reading comprehension.
- o They will be in a position to deploy study skills such as close reading and coherent writing at a C1-level and for use in niche tasks for the industrial engineering sector.
- o They will have gained substantial knowledge of C1-level language registers – both for formal study contexts and for semi-formal to formal professional contexts.





- o They will have gained essential experience in presenting on topics related to technical English. The goal here is to package niche knowledge in the protocols of a clearly structured, effectively delivered piece of public speaking.

#### Methodological competencies

- o Students will have enhanced their abilities to structure the acquisition of specialized terminology and grammatical items and practiced ways to internalize new language that yield optimal learning benefits.
- o They will have extended and refined their practical research skills in English by engaging in at least two research projects – for example, by being asked to present on a discipline-specific topic in an individual or team presentation.

#### Social competencies

- o Students will have gained valuable experience in training other personal effectiveness skills such as team work, integrity, and reliability.
- o They will have reflected on the learning benefits derived from several immersion projects.

#### **Other language course**

Please see the respective course descriptions.

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

The module can also be chosen by students of other fields of study.

### **Entrance Requirements**

The minimum entry-level requirement is C1-level of English according to the Common European Framework of Reference for Languages (CEFR) or A-level language skills according to the standards of the German education system. Alternatively, experience living abroad or successful participation in a study exchange may be sufficient.

### **Learning Content**

#### **Presentation skills for technical purposes (C1)**

Communication skills for technical contexts, including a review and consolidation of the topics dealt with in Foreign Language III (Technical English (C1)), with a special focus on presentations.

- o technical presentations, discussions and negotiations
- o commercial correspondence on technical topics
- o renewable energies and sustainability



- o product and project management
- o complaint management, service and repair
- o the future of cars
- o case study on an area related to technology/design/engineering
- o review of some grammar items

## Teaching Methods

Instruction and learning methods focus on training the four cardinal language skills (speaking, listening, reading, and writing) and on enhancing professional and social competencies. They include group discussions and group projects, individual and team work (e.g. individual and group presentations), real- and role-playing, close reading and listening activities, grammar games, method of loci, running dictations, translations, peer feedback and review, work with learning stations, and various follow-up viewing and writing activities.

Study assignments will be set on a weekly basis.

## Recommended Literature

Recommended reading for Presentation skills for technical purposes (C1)

Bonamy, David. *Technical English 4*. Harlow, England: Pearson Education, 2011.

Print.

Dunn, Marian, David Howey, and Amanda Ilic. *English for Mechanical Engineering in Higher Education Studies Coursebook*. Reading: Garnet Education, 2010. Print.

engine: Englisch für Ingenieure. Darmstadt. <[www.engine-magazin.de](http://www.engine-magazin.de)>

Ibbotson, Mark. *Professional English in Use Engineering Technical English for Professionals*. Cambridge: Cambridge UP, 2009. Print.

Inch. *Inch, das neue Sprachmagazin für technisches English*. <[inchbyinch.de](http://inchbyinch.de)>

Möllerke, Georg. *Modern English for Mechanical Engineers*. Munich: Carl Hanser Verlag, 2010. Print.

Recommended reading for other language



Please see the respective course descriptions for literature references.



## IE-26 FUNDAMENTALS OF MEASUREMENT AND CONTROL ENGINEERING

Module code	IE-26
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Fundamentals of Measurement and Control Engineering
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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.
Weight	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 Metrology
- 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-27 APPLIED MEASUREMENT AND CONTROL ENGINEERING

Module code	IE-27
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Applied Measurement and Control Engineering
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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	report/presentation
Weight	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 Program**

IE-Elective Industrial Automation and Information Technology



## 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 current and voltage
- o Measurement of apparent, reactive and active power
- o Measuring electrical work
- 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-28 PROCESS RELIABILITY

Module code	IE-28
Module coordination	Prof. Dr. Rui Li
Course number and name	IE-28 Process Reliability
Lecturer	Prof. Dr. Rui Li
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.
Weight	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 Program**

IE-Elective Operational Processes

IE-Elective Process Engineering

### **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)

Chemistry (IE-18)

## 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

## Remarks

Excursion to companies can be offered

## 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-29 INTERCULTURAL COMPETENCES

Module code	IE-29
Module coordination	Prof. Dr. Michelle Cummings-Koether
Course number and name	Intercultural Competences
Lecturer	Prof. Dr. Michelle Cummings-Koether
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: 10 hours virtual learning: 10 hours Total: 80 hours
Type of Examination	report/presentation
Weight	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 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 other’s 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
- o Familiar with different cultural standardization model, and how to apply these to various cultures
- 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.

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

## 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

## Teaching Methods

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

## Recommended Literature

Hall, E. T., Hall, M. R. (2015). *Understanding Cultural Differences*. Yarmouth: Intercultural Press.

Hofstede, G. (2015). *Cultures and Organizations*. New York: Mc Graw-Hill.

Trompenaars, F. & Hampden-Turner, C. (1997). *Riding the Waves of Culture*. London: Brealey Publishing.

Trompenaars, F., Hampden-Turner, C. (2004). *Managing People across Cultures*. Chichester: Capstone Publishing.

Lewis, R. D. (2006). *When Cultures Collide*. London: Brealey Publishing.



## IE-30 SUSTAINABILITY

Module code	IE-30
Module coordination	Prof. Dr. Raimund Brotsack
Course number and name	IE-30 Sustainability
Lecturers	Prof. Dr. Bernhard Bleyer 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 student research project
Weight	5/210
Language of Instruction	English

### Module Objective

Using selected examples out of the field of Sustainable Development Goals and based on the fundamentals of natural science and renewable energies, students learn about various aspects of sustainable product and process evaluation.

#### Professional competence:

##### Knowledge

Students acquire in-depth knowledge of the material cycles in nature with the aim of deriving strategies for sustainable development. In addition, students learn about the effects of the emission of climate-damaging gases from transport, trade and industry as well as climate-induced changes in nature and society. They will understand the basic strategies in the field of material and energy resource saving and efficient behaviour. The module is rounded off by an introduction to certification systems for the uniform evaluation of sustainable professional actions.

##### Skills

The acquired knowledge forms the basis for an understanding of the challenges associated with the transformation towards a sustainable industrial society. Practical examples enhance the knowledge. Students are able to analyse and evaluate



technologies and processes regarding the SDG´s especially in the field of affordable an clean energy, responsible consumption and production and climate action.

**Method competences:**

After participating in this module, the students will be able to critically analyze subject-specific information on energy and material efficiency while evaluating climate relevance and to observe the principles of sustainable development when developing new technologies, production processes and procedures.

**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.

**Applicability in this Program**

IE-32 Project Work

**Applicability in this and other Programs**

(Modul "Sustainability" planed in other faculties at THD)

**Entrance Requirements**

Chemistry (IE-18)

Renewable Energies (IE-22)

**Learning Content**

**Environment an Climate**

- o Definition of sustainability
- o History of sustainability (Club of Rome, Bruntlandt, Agenda 21, Millennium Development Goals, Climate Change, ...)
- o Chemisty of the atmosphere
- o climate changing gases and greenhouse effect
- o Environmental protection and nature conservation

**Certification systems**

- o The systematic approach of the Sustainable Development Goals (SDGs)



- o The United Nations Global Compact, the ISO 26000 and the OECD Guidelines for Multinational Enterprises as international frameworks for the assessment of sustainable development
- o The GRI Sustainability Reporting Standards – Its guidelines and practical experience
- o The VDI 4605 Evaluation of sustainability – a guidance for engineers
- o Standards and legal requirements
  - o Environmental Management Systems (Environmental Product Declaration, Cradle to Cradle, DGNB, BREEAM, LEED, EMAS)
  - o energy saving regulation, Product laws relevant to energy consumption, Greenhouse Gas Emissions Trading Act, building products regulation, Closed Substance Cycle and Waste Management Act

### **Excursion, workshop, teamwork**

The students experience, reflect and evaluate personally natural circulatory systems as a basis for transferring these experiences with regard to sustainability education in the further course of studies to resource-oriented technical circulatory systems and to evaluate the desired and undesirable effects of influencing these systems in a new, appropriate manner, case-based project work in intercultural and international teams.

## **Teaching Methods**

seminaristic teaching / exercises / tutorials / home work / excursion (tactile, psychological and practical experience in the framework of the "Education for Sustainable Development" methodology, followed by reflection)

## **Remarks**

Excursion to the Youth Education Institute and the Environmental Education Station Windberg

## **Recommended Literature**

- o Sustainable development goals  
(<http://www.un.org/sustainabledevelopment/climate-change-2/>)
- o IPCC – perspectives on climate change and sustainability:  
(<https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter20.pdf>)
- o Michael Blowfield; „Business and Sustainability (Englisch)“ publisher: Oxford University Press; Auflage: New (8. Februar 2013); ISBN-10: 0199642982; ISBN-13: 978-0199642984



- o R. Friedel, E. A. Sindler (Hrsg.); „Zertifizierung als Erfolgsfaktor – Nachhaltiges Wirtschaften mit Vertrauen und Transparenz“; Springer-Verlag, 2016 / ISBN: 3658097019, 9783658097011
- o VDI 4605 Evaluation of sustainability. Düsseldorf 2017.
- o Global Reporting Initiative, G4 Sustainability Reporting Guidelines. Implementation Manual. Amsterdam 2013.
- o UN Global Compact, Guide to Corporate Sustainability. Shaping a Sustainable Future. New York 2014
- o DIN EN ISO 14001
- o ENEC
- o EVPG
- o KrW-/AbfG
- o EU *Emissions Trading* Scheme (EU ETS) - Greenhouse gas emission trading act



## IE-31 MANAGEMENT

Module code	IE-31
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Management Lean Management
Lecturers	Prof. Markus Hainthaler Prof. Dr. Sascha Kreiskott
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.
Weight	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 Program**

IE-33 Internship including PLV 1 and PLV 2

IE-37 Bachelor Module

IE-Elective Process Optimization

### **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-32 PROJECT WORK

Module code	IE-32
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Project work with report
Lecturer	Prof. Dr. Sascha Kreiskott
Semester	5
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	6
ECTS	6
Workload	Time of attendance: 90 hours self-study: 90 hours Total: 180 hours
Type of Examination	report and presentation
Weight	6/210
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 INTERNSHIP INCLUDING PLV 1 AND PLV 2

Module code	IE-33
Module coordination	Prof. Dr. Sascha Kreiskott
Course number and name	Internship
Lecturer	Prof. Dr. Sascha Kreiskott
Semester	2, 6
Duration of the module	2 semester
Module frequency	
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	30
ECTS	26
Workload	Time of attendance: 90 hours self-study: 420 hours Total: 510 hours
Type of Examination	presentation 20 min., internship certification
Weight	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. Stefan Mátéfi-Tempfli
Course number and name	Bachelor thesis Applied communication techniques
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
Semester	7
Duration of the module	1 semester
Module frequency	annually
Course type	required course
Level	Undergraduate
Semester periods per week (SWS)	14
ECTS	15
Workload	Time of attendance: 60 hours self-study: 30 hours virtual learning: 360 hours Total: 450 hours
Weight	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

## ▶ **BACHELOR THESIS**

### **Type of Examination**

bachelor thesis

## ▶ **APPLIED COMMUNICATION TECHNIQUES**

### **Type of Examination**

oral ex. 30 min.



## IE-ELECTIVE PROCESS ENGINEERING

Module code	IE-Elective
Module coordination	Prof. Markus Hainthaler
Course number and name	Process Engineering
Lecturer	Prof. Markus Hainthaler
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.
Weight	5/210
Language of Instruction	English

### Module Objective

#### Professional and methodological competences:

##### *Knowledge*

After being taught the broad fundamentals of Industrial Engineering, this elective module in the last semester 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 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-07), Physics (IE-11), Chemistry (IE-18), Technical Mechanics II (IE-09), Plant Engineering (IE-23), Energy Technology (IE-16), Renewable Energies (IE-22)

### **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 / endothermal / exothermal 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 DATA ACQUISITION AND PROCESSING

Module code	IE-Elective
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Data Acquisition and Processing
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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
Weight	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 and Digital-to-Analog Converters
- o Quantization errors and coding
- o Oversampling A/D and D/A converters
- 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 INDUSTRIAL AUTOMATION AND INFORMATION TECHNOLOGY

Module code	IE-Elective
Module coordination	Prof. Dr. Stefan Mátéfi-Tempfli
Course number and name	Industrial Automation and Information Technology
Lecturer	Prof. Dr. Stefan Mátéfi-Tempfli
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
Weight	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 ENERGY AND RESOURCE EFFICIENCY

Module code	IE-Elective
Module coordination	Prof. Dr. Rui Li
Course number and name	Energy and Resource Efficiency
Lecturer	Prof. Dr. Rui Li
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.
Weight	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 Program**

IE-16 Energy Technology

IE-22 Renewable Energies

**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 MODELLING THEORY

Module code	IE-Elective
Module coordination	Prof. Dr. Robert Feicht
Course number and name	Modelling Theory
Lecturer	Prof. Dr. Robert Feicht
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.
Weight	
Language of Instruction	English

### Module Objective

#### Professional and methodological competence

Based on the learning outcomes of Principles in Business (IE-05), Applied Mathematics (IE-14), and Logistics and Operations Research (IE-21), after successfully completing this module, students will be able to classify and formally describe the various strategic interactions (games) in practice.

#### Knowledge

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

#### Skills

- o Students are able to conceptualize "rational behavior" and to identify adequate solutions for decision situations.
- o Students recognize the influence of intuition and societal expectations on decision-making.

#### Personal competence



### *Social competence*

- o The assumptions regarding rationality and self-interest in economic theory are critically questioned.
- 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 student's discussion and presentation skills in the academic context.

### *Autonomy*

- o The students can independently identify, model and analyze strategic aspects of economic, political and social interactions.
- 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 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"; 1st edition; Harlow: Prentice Hall, Pearson Education; 1992.

Vega-Redondo F.; "Economics and the Theory of Games"; 1st edition; New York: Cambridge University Press; 2003.

### Supplementary literature

Fudenberg D., Tirole J.; "Game Theory"; 1st edition; Cambridge: MIT Press; 1991.

Myerson R.B.; "Game Theory. Analysis of Conflict"; 1st edition; Harvard University Press; 1991.

Mas-Colell A., Whinston M.D., Green J.R.; "Microeconomic Theory"; 1st edition; Oxford University Press; 1995.

Dixit A.K., Skeath S., Reiley D.H.; "Games of Strategy"; 4th edition; New York: Norton; 2013.



## IE-ELECTIVE PROCESS OPTIMIZATION

Module code	IE-Elective
Module coordination	Prof. Markus Hainthaler
Course number and name	Process Optimization
Lecturers	Prof. Markus Hainthaler Norbert Sosnowsky
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.
Weight	5/210
Language of Instruction	English

### Module Objective

#### Professional and methodological competences:

##### *Knowledge*

From the diversity of engineering courses in the previous semesters, the students are already capable of analysing 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 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-23), Energy Technology (IE-16), Renewable Energies (IE-22), Sustainability (IE-30), Management (IE-31)

## 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 (incl. FMEA, FTA)
- o Process Integration: Process Economics, Global Optimality, Heat Exchanger Networks (Pinch Method)
- o Environmental Design: 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



## IE-ELECTIVE INSIGHTS INTO THE CORPORATE WORLD

Module code	IE-Elective
Module coordination	Claudia Hageneder
Course number and name	Insights into the Corporate World
Lecturer	Claudia Hageneder
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
Weight	
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 GLOBALISATION

Module code	IE-Elective
Module coordination	Prof. Dr. Michelle Cummings-Koether
Course number and name	Globalisation
Lecturer	Prof. Dr. Rui Li
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
Weight	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**

- 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 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 ENERGY MARKETS

Module code	IE-Elective
Module coordination	Prof. Dr. Rui Li
Course number and name	Energy Markets
Lecturer	Prof. Dr. Rui Li
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.
Weight	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 BUSINESS PLANNING AND START-UP MANAGEMENT

Module code	IE-Elective
Module coordination	Prof. Dr. Raimund Brotsack
Course number and name	Business Planning and Start-Up Management
Lecturer	Prof. Dr. Raimund Brotsack
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
Weight	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 Program**

IE-37 Bachelor Module

## **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 OPERATIONAL PROCESSES

Module code	IE-Elective
Module coordination	Prof. Dr. Rui Li
Course number and name	Operational Processes
Lecturer	Prof. Dr. Rui Li
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.
Weight	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, VDIVerlag, Düsseldorf
- o Laux, H., Liermann, F.: Grundlagen der Organisation. Springer, 6. Aufl. Berlin 2005

