Technische Hochschule Nürnberg

Fakultät Maschinenbau und Versorgungstechnik

Module handbook

Bachelor's degree programme

Mechanical Engineering

B-MEC

English version

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1 Study objectives and Competence profile

1.1 Study objective

The Bachelor's degree programme in Mechanical Engineering is an undergraduate degree programme and leads to a professional qualification as a mechanical engineer after seven semesters of standard study time.
The aim is to acquire the knowledge and skills to independently apply scientific findings and methods in mechanical engineering. The comprehensive basic training, which reflects the breadth and diversity of mechanical engineering, enables students to quickly familiarise themselves with one of the numerous fields of application in practice in a scientifically sound manner and to act responsibly.
By choosing a specialisation, the fundamentals of mechanical engineering are applied and deepened in important fields of work in mechanical engineering; specialisation is not associated with this. In addition to imparting specialised knowledge, key qualifications such as learning and working techniques, teamwork and communication skills are promoted.

1.2 Learning outcomes to be achieved through the programme

In accordance with the recommendations of the "Accreditation Agency for Study Programmes in Engineering, Computer Science, Natural Sciences and Mathematics" (ASI IN), the modules of the Bachelor's degree programme take the following categories into account:

- Mathematical and scientific basics
- Engineering fundamentals
- Engineering applications
- Interdisciplinary teaching content
- Practical training, bachelor thesis

The following summary assigns the individual modules/sub-modules of the curriculum to these categories and explains the learning outcomes to be achieved in this context.

Mathematical and scientific basics:

The aim of the mathematical and scientific foundation modules is to impart the basic knowledge, skills and competences that students need for the Mechanical Engineering degree programme. This builds on the level of education defined by the university entrance qualification. This is deepened and expanded in preparation for the engineering fundamentals. This module group predominantly forms the first stage of the Bachelor's degree programme (1st and 2nd semesters); the following modules belong to this group:

- Engineering Mathematics I and II
- Physics
- Numerical Methods
- Computer Science

Engineering fundamentals:

The aim of the engineering fundamentals modules is to create a broad basis for engineering methods and procedures in order to be able to identify, formulate and solve the diverse problems of mechanical engineering. This builds on the mathematical and scientific foundations of the first two semesters. The following modules belong to this group:

- Engineering Mechanics I, II and II
- Materials Science I and II
- Electrical Engineering
- Thermodynamics
- Heat Transfer
- Fluid Mechanics
- Machine Dynamics
- Control Engineering and Mechatronics

Engineering applications:

The aim of the engineering applications modules is to teach students how to apply basic knowledge in important areas of mechanical engineering. Students are taught the skills and competences to independently recognise and solve mechanical engineering problems. This module group is predominantly found in the fourth to seventh semesters of study. The following subjects belong to this group:

- Machine Elements I and II
- Engineering Design I, II and III
- Manufacturing Technology

Profile development, specialisation

Building on the fundamentals and engineering applications, the modules in the 6th and 7th semesters impart in-depth knowledge and skills in important professional fields of mechanical engineering with a focus on numerical calculation and simulation. In the modules and study projects, students are taught the skills to recognise and work on problems in mechanical engineering in a holistic, interdisciplinary manner.

Interdisciplinary teaching content

The task of the modules with overarching content is to train specialised areas such as languages, business administration, law, but also topics such as rhetoric, teamwork, presentation skills and the preparation of technical reports. These skills are also taught in individual subjects in the specialisations, and to some extent also in engineering applications. Students can bring in their own interests as part of the general science electives. The following modules belong to this group:

- Cross-Cultural Training/Employability and Working in Germany
- Research Methods and Scientific Writing
- Practical seminar

Practical training and Bachelor's thesis

The knowledge, skills and competences acquired in the preceding module groups are applied and deepened in the practical semester (5th semester) in the project work of the specialisations and the final Bachelor's thesis. In the Bachelor's thesis, students solve a set task independently using subject-specific and scientific methods. The topics are set by the professors of the faculty and are worked on at the university or in companies. The following modules belong to this group:

- Practical semester with practical seminar
- Bachelor thesis with bachelor seminar

1.3 Objectives of individual modules

The matrix below provides an overview of the overarching learning objectives to be achieved with the modules/sub-modules. The specific learning objectives of the individual modules are described in the module sheets from section 2 onwards.

Goals matrix:

Overarching learning objectives	**Concrete learning objectives**	**Modules**
Expertise and understanding	Acquisition of comprehensive engineering, mathematical and scientific knowledge of mechanical engineering, which enables students to work in a scientifically sound manner and to act responsibly in their professional activities.	**Engineering Mathematics** **Physics** **Engineering Mechanics** **Materials Science** **Computer Science** **Electrical Engineering** **Thermodynamics** **Fluid Mechanics** **Machine Dynamics** **Control Engineering**
	Acquire an understanding of the multidisciplinary context of engineering.	**Machine Elements** **Engineering Design**
Independent application of scientific findings and methods	Ability to identify, formulate and solve mechanical engineering problems using established scientific methods.	**Engineering Design** **Practical semester with practical seminar** **Bachelor thesis, Bachelor seminar**
	Ability to scientifically analyse products, processes and methods in their discipline.	**Engineering Mechanics** **Machine Elements** **Engineering Design**
	Ability to select suitable analysis, modelling, simulation and optimisation methods and apply them with a high level of handling competence.	**Computer Science** **Data Science**

Engineering development and design	Acquire the ability to develop designs for machines, equipment, computer programmes or processes according to their level of knowledge and understanding and in accordance with specified requirements. Acquisition of a practice-orientated understanding of design methodologies and the ability to apply these competently.	**Machine Elements** **Engineering Design** **Computer Science** **Manufacturing Technology** **Practical semester with practical seminar** **Bachelor thesis, Bachelor seminar**
Investigate and evaluate	Ability to conduct literature research according to their level of knowledge and understanding and to use databases and other sources of information for their work. Ability to plan and carry out suitable experiments according to their level of knowledge and understanding, to interpret the data and to draw appropriate conclusions.	**Physics** **Electrical Engineering** **Machine Dynamics** **Manufacturing Technology** **Control Engineering** **Practical semester with practical seminar** **Bachelor thesis, Bachelor seminar**
Engineering practice	Ability to transfer new findings from engineering and natural sciences to industrial and commercial production, taking into account economic, ecological and safety requirements. Ability to plan, control and monitor processes, develop and operate systems and equipment. Ability to deepen the acquired knowledge independently. Awareness of the non-technical implications of engineering activities.	**Physics** **Machine Dynamics** **Manufacturing Technology** **Control Engineering** **Mechatronics** **Practical semester with practical seminar** **Bachelor thesis, Bachelor seminar**

Social skills	Ability to communicate in a foreign language and interculturally about the content and problems of the discipline both with specialist colleagues and with a wider public. Awareness of social and ethical responsibility and knowledge of professional ethical principles and standards. Ability to work both individually and as a member of international and mixed-gender groups, to organise projects effectively and to assume leadership responsibility. Ability to socialise and work in a business or scientific environment through sufficient practical relevance. Enabling lifelong learning.	**Engineering Design** **Scientific Working** **Cross-Cultural Training** **Control Engineering** **Mechatronics** **Practical semester with practical seminar** **Bachelor thesis, Bachelor seminar**

2 Module descriptions

2.1 Engineering Mathematics I

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Areti Papastavrou	Prof Dr Felix Boy, Prof. Dr.-Ing. Areti Papastavrou, Prof. Dr.-Ing. Franziska Vogel-Brinkmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
None
Contents
• Functions of a real variable (properties of functions, inverse function, polynomials, fractional rational functions, exponential and logarithmic functions, trigonometric functions, hyperbolic and area functions)

- Complex numbers (properties of complex numbers, arithmetic with complex numbers, polar form, powers and roots of complex numbers, polynomials with complex numbers, fundamental theorem of algebra, application of complex numbers to the representation of oscillations)
- Linear algebra (linear systems of equations, vector and matrix calculus, determinants, linear coordinate transformations, eigenvalue problems)
- Differential calculus in one real variable and its applications (linearisation, curve discussion)
- Sequences and series (limits, convergence and divergence criteria, special sequences and special series)
- Taylor development and power series (Taylor formula, radius of convergence, composition of power series, power series development of basic functions (including binomial series), application to the calculation of limits of functions (de l'Hospital's rule))

Qualification goal

- Sound knowledge and in-depth understanding of the mathematical concepts, laws, ways of thinking and methods specifically relevant to mechanical engineering.
- Ability to transfer technical problems to mathematical models and to apply suitable mathematical solution methods.

Usability

Compulsory module

Literature

Esfandiari, R.S.: Applied Mathematics for Engineers, Atlantis, Irvine, California

Kreyszig, E., Normington, E.J.: Advanced Engineering Mathematics and Maple computer guide, John Wiley-Sons

Burg, K., Haf, H., Wille, F., Höhere Mathematik für Ingenieure, Band I, II, III, Teubner

Fetzer, A., Fränkel, H., Mathematics, Volume 1,2, Springer

Meyberg, K., Vachenauer, P., Höhere Mathematik, Volume 1,2, Springer

Papula, L., Mathematics for Engineers and Natural Scientists, Vol. 1, 2, Vieweg

Schott, D., Engineering Mathematics with MATLAB: Algebra and Analysis, Fachbuchverlag Leipzig

Stry, Y., Schwenkert, R., Mathematik kompakt: für Ingenieure und Informatiker, Springer-Verlag

Stingl, P., Mathematics at Universities of Applied Sciences, Hanser

Westermann, Th., Mathematics for Engineers with Maple, Volume 1, 2, Springer-Verlag

2.2 Engineering Mechanics I (Statics and Strength of Materials Basics)

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Felix Boy	Prof Dr Felix Boy, Prof. Dr.-Ing. John-Glen Swanson	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
None

Contents
Statics: concept of force - axioms of statics - central and non-central force systems - support reactions of load-bearing structures - centre of gravity - section reactions - adhesion and friction. Strength theory: Stress concept - Hooke's law of matter - material properties and permissible stresses - stress determination and strength verification for the basic load types in statically determined systems under tension/compression, bending, torsion, shear force.

Qualification goal
Application of basic mechanical laws to static and uniaxially loaded, elastostatic systems, skills for determining support and cutting reactions as well as mechanical stresses, acquisition of skills for analysing and dimensioning machine parts with regard to safety.

Usability
Compulsory subject

Literature
R.C. Hibbeler: Engineering Mechanics 1 + 2. Pearson. S. Kessel, D. Fröhlich: Engineering Mechanics: Bilingual Textbook on the Fundamentals of Solid Mechanics. Springer Verlag. D. Gross et al: Engineering Mechanics 1 + 2, Springer Vieweg. C. Eller: Holzmann/Meyer/Schumpich - Engineering Mechanics - Statics. Springer Vieweg. V. Läpple: Introduction to Strength of Materials, Springer

2.3 Physics

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	3	Presence	55
Prof Dr Norbert Koch	Prof Dr Norbert Koch	Pr	-	Self-study	95
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
None

Contents
• Vibration theory: Harmonic and damped vibrations, forced vibration (resonance), superposition of vibrations • Wave theory: properties, propagation and interaction of waves, waves at interfaces • Acoustics: propagation of sound waves, sound level and sound intensity, ultrasound • Electromagnetic waves: Origin and properties, diffraction at slit and grating • Radiation and quanta: Photoelectric effect, thermal radiation

Qualification goal
Understanding of physical processes; ability to describe these processes mathematically, derive applications and recognise general relationships from the observation of specific processes; sense of scale
Usability
Compulsory module
Literature
P. Tipler, G. Mosca: "Physics for Engineers and Scientists", 6th Edition 2007, Publisher: WH Freeman; ISBN-10: 1429202653, ISBN-13: 978-1429202657 E. Hering, R. Martin, M. Stohrer: Physics for Engineers. Springer Vieweg. F. Kuypers: Physics for engineers and scientists. Wiley-VCH. D. Halliday, R. Resnick, J. Walker: Halliday Physics. Wiley-VCH. P. Tipler, G. Mosca: Physics. Springer Spectrum. U. Harten: Physics: An introduction for engineers and scientists. Springer Vieweg. H. Paus: Physics in Experiments and Examples. Hanser-Verlag.

2.4 Materials Science I

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	4	Total	150
Responsible for the module	**Lecturer**	Ü		Presence	45
Prof. Dr.-Ing. Berthold von Großmann	Prof. Dr.-Ing. John-Glen Swanson, Prof. Dr.-Ing. Berthold von Großmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
None
Contents

- Structure of materials (metals, ceramics, plastics), lattice structure, crystal formation, mechanisms of deformation
- Essential properties and internal structure of metallic materials
- Various standardised mechanical, technological, physical, chemical and non-destructive testing methods
- Phase transformation in metallic materials. Binary state diagrams, development of the iron-carbon diagram, annealing and hardening processes, ZTU diagrams, alloy formation
- Effect of alloying elements on the microstructure, mechanical properties and other material properties
- Influence of manufacturing and processing methods on material properties
- Standardised designation of metallic materials with examples
- Insight into material damage Types, development, minimisation and prevention

- Properties, production and application of steel and aluminium

Qualification goal

- Knowledge of the appropriate treatment and application of metallic materials in mechanical engineering.
- Knowledge of various material testing methods
- Ability to recognise the relationship between material structure and performance properties.
- Basic ability to implement scientific knowledge of materials science for scientifically sound work in the engineering profession.
- Ability to select materials according to requirements

Usability

Compulsory module

Literature

W. D. Callister: Materials science and engineering, Wiley

2.5 Engineering Design I (including CAD I)

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	StA, schrP 90 min	SU	4	Total	150
Responsible for the module	**Lecturer**	Ü	1	Presence	55
Prof. Dr.-Ing. Michael Koch	Prof. Dr John-Glen Swanson, Prof. Dr Michael Koch	Pr	-	Self-study	95
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

None

Contents

- Technical representation theory, technical drawings, other components of technical documentation, standardisation, basics of replacement construction, design of technical objects
- Tolerances, fits, form and position tolerances, tolerance chain calculation
- Assemblies, parts lists, standard parts
- Creation of product models and their documentation
- CAD I: Design and functional structure of a 3D CAD system, modelling of volume design elements and individual parts, use of standard design elements, creation of individual part drawings, modelling of assemblies, creation of assembly drawings.

Qualification goal

- Knowledge of the technical product documentation.
- Knowledge of the correct component representation on the drawing.
- Knowledge of standard parts and standardised structural design elements.

- Knowledge of dimensional tolerances and fits.
- Knowledge of basic shape and position tolerances.
- Knowledge of the ISO GPS system.
- Skills in creating drawings by hand.
- Skills in conventional methods of product documentation and in CAD-supported working methods.
- Basic knowledge of the design and functional structure of a fully parameterised 3D CAD system.
- Ability to create individual parts using a CAD system as a solid model and to create structured assemblies.
- Ability to derive functional and production-orientated parts drawings from CAD systems.
- Knowledge of advanced 3D CAD functionalities such as building and analysing an assembly as a kinematic model

Usability

Compulsory module

Literature

Europa-Verlag: Mechanical and Metal Trades Handbook (Tabellenbuch Metall)

Rathnam, K.: A First Course in Engineering Drawing

Green, Paul: The geometrical tolerancing desk reference : creating and interpreting ISO standard technical drawings

Brian Griffiths: Engineering Drawing for Manufacture

Er Alok Kumar Jha: Fundamentals of Engineering Drawing: A to Z of Principles of Orthographic Projection, Projections of Points & Projections of Lines

Paul Green: The Geometrical Tolerancing Desk Reference : Creating and Interpreting ISO Standard Technical Drawings

Frederick E. Giesecke: Technical Drawing with Engineering Graphics

2.6 Language I

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	3	Total	150
Responsible for the module	**Lecturer**	Ü	3	Presence	72
from Lennep-Reeder	LB Language Centre, Zinger	Pr	-	Self-study	78
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	German			

Recommended prerequisites

Completed level A1

Contents

- Consolidation of previous knowledge of level A1
- Various topics from everyday life, studies and work.
- Reading and listening comprehension, speaking skills and writing training.

- Vocabulary and grammar.

Qualification goal

Learners can:

- understand frequently used expressions and phrases about yourself and your family, shopping, work and the local area.
- communicate in simple, routine situations involving simple, direct exchanges about familiar things.
- use simple means to describe their own background and education, their immediate surroundings and immediate needs.

Usability
Compulsory module

Literature
Textbook: DaF kompakt neu A2. Course and exercise book. Stuttgart: Klett

2.7 Engineering Mathematics II

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Franziska Vogel-Brinkmann	Prof Dr Felix Boy, Prof. Dr.-Ing. Areti Papastavrou, Prof. Dr.-Ing. Franziska Vogel-Brinkmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Mathematics I

Contents

- Curves (parameterisation of curves, curve discussion of parameterised curves)
- Functions of several variables (forms of representation and visualisation; continuity; multidimensional differential calculus with applications such as error calculation and extreme value tasks)
- Integral calculus in one real variable and its applications
- Integral calculus in several real variables (plane and spatial domain integrals, integration over normal domains, transformation formula (especially polar, cylindrical and spherical coordinates)) and their applications (calculation of area, volume and centres of gravity of curvilinearly bounded areas in two and three spatial dimensions))
- Curve integrals (integrals of vector fields or scalar fields along curves, calculation of curve lengths, calculation and use of potential functions)
- Ordinary differential equations (linear and non-linear differential equations of the first order, linear differential equations of the second and higher order, linear systems of differential equations)

Qualification goal

Sound knowledge and in-depth understanding of the mathematical concepts, laws, ways of thinking and methods specifically relevant to mechanical engineering.

Usability

Compulsory module

Literature

Esfandiari, R.S.: Applied Mathematics for Engineers, Atlantis, Irvine, California

Kreyszig, E., Normington, E.J.: Advanced Engineering Mathematics and Maple computer guide,

John Wiley-Sons

Burg, K., Haf, H., Wille, F., Höhere Mathematik für Ingenieure, Band I, II, III, Teubner

Fetzer, A., Fränkel, H., Mathematics, Volume 1,2, Springer

Meyberg, K., Vachenauer, P., Höhere Mathematik, Volume 1,2, Springer

Papula, L., Mathematics for Engineers and Natural Scientists, Vol. 1, 2, Vieweg

Schott, D., Engineering Mathematics with MATLAB, Fachbuchverlag Leipzig

Stry, Y., Schwenkert, R., Mathematik kompakt: für Ingenieure und Computer Scienceer, Springer-Verlag

Stingl, P., Mathematics at Universities of Applied Sciences, Hanser

Westermann, Th., Mathematics for Engineers with Maple, Volume 1, 2, Springer-Verlag

2.8 Engineering Mechanics II (specialisation in strength of materials)

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Felix Boy	Prof. Dr.-Ing. Felix Boy, Prof. Dr.-Ing. John-Glen Swanson	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mechanics I, Engineering Mathematics I, Materials Science I

Contents

- Multiaxial loading: stress and distortion tensor - generalised Hooke's law - tensor transformation - Mohr's stress circle - strength hypotheses - strength verification under static loading.
- Deformation in tension/compression, bending, torsion and shear: differential equations of the beam and the bending line - analysis of statically indeterminate systems.
- Strength verification for vibrating loads: stress determination - strength parameters - fatigue strength verification for uniaxial and multiaxial loads.

Qualification goal

Application of basic mechanical laws to elastostatic systems subjected to multiaxial loads, skills for determining mechanical stresses and deformations under multiaxial loads, acquisition of skills for analysing and dimensioning components under static and oscillating loads with regard to safety and economic efficiency.

Usability

Compulsory module

Literature

R.C. Hibbeler: Mechanics of Materials. Pearson.

D. Gross et al: Engineering Mechanics 2, Springer Vieweg.

L. Issler et al: Strength of materials - Fundamentals. Springer.

H. Altenbach: Holzmann/Meyer/Schumpich - Engineering Mechanics - Strength of Materials. Springer Vieweg.

2.9 Machine Elements I

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Alexander Monz	Prof. Dr.-Ing. John-Glen Swanson, Prof. Dr.-Ing. Alexander Monz, Prof. Dr.-Ing. Thomas Wimmer	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering fundamentals in mathematics, physics, technical mechanics, materials science I

Contents

Fundamentals of calculating machine elements, introduction to fatigue strength, welded joints, other material-locking joints, bolted joints and moving threads, technical springs

Qualification goal

- Ability to dimension and calculate machine elements in compliance with standards and design regulations.
- Knowledge of the selection, characteristics and application of machine elements according to functional, calculation and engineering design principles as well as economic requirements.

Usability

Compulsory module

Literature

Shigley's Mechanical Engineering Design

Roloff / Matek: Machine elements with table book

Hoischen: Technical drawing

Small: Introduction to DIN standards

Dubbel: Pocket book for mechanical engineering

2.10 Computer Science

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	StA, schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Philipp Gölzer	Philipp Gölzer, Prof. Dr.-Ing. Felix Boy, Prof. Dr.-Ing. John-Glen Swanson, Prof. Dr.-Ing. Franziska Vogel-Brinkmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

None

Contents

- Basics, installation, syntax, variables and data types
- Control structures (branches, loops)
- Functions (definition, use, parameters)
- Data structures (lists, dictionaries, sets)
- File operations (read, write, exceptions)
- Modular programming (modules, packages)
- Object-orientated programming (classes, objects, inheritance)
- Error handling, debugging and tests
- Data processing and data visualisation
- Applications in mechanical engineering and technology

Qualification goal

- Understanding of basic programming concepts
- Understanding the concept of modular programming
- Abstraction of questions and their mapping in algorithms
- Knowledge and application of control structures and object-orientated programming
- Knowledge and application of techniques for error handling and testing
- Application of Python for questions in mechanical engineering
- Independent realisation of programming tasks

Usability

Compulsory module

Literature

Eric Matthes: Python Crash Course, No Starch

John V. Guttag: Introduction to Computation and Programming Using Python: With Application to Understanding Data; MIT Press Academic

2.11 Engineering Design II (including CAD II)

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	StA, StA (CAD)	SU	1	Total	150
Responsible for the module	**Lecturer**	Ü	3	Presence	45
Prof. Dr.-Ing. Alexander Monz	Prof. Dr.-Ing. Alexander Monz, Prof. Dr.-Ing. John-Glen Swanson, Prof. Dr.-Ing. Michael Koch	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

None

Contents

- Technical representation theory, technical drawings, other components of technical documentation, standardisation, basics of replacement construction, design of technical objects
- Creation of product models and their documentation.
- CAD2: Creation of assemblies with skeleton models, creation of kinematic assemblies and simulations derived from them, surface modelling at component level

Qualification goal

- Knowledge of the technical product documentation
- Knowledge of the correct component representation on the drawing
- Knowledge of standard parts and standardised structural design elements
- Knowledge of dimensional tolerances and fits
- Knowledge of basic shape and position tolerances
- Knowledge of the ISO GPS system
- Skills in creating drawings by hand
- Skills in conventional methods of product documentation and in CAD-supported working methods
- Basic knowledge of the design and functional structure of a fully parameterised 3D CAD system.
- Ability to create individual parts using a CAD system as a solid model and to create structured assemblies.
- Ability to derive functional and production-orientated parts drawings from CAD systems.
- Knowledge of advanced 3D CAD functionalities such as building and analysing an assembly as a kinematic model

Usability

Compulsory module

Literature
Europa-Verlag: Mechanical and Metal Trades Handbook (Tabellenbuch Metall)
K. Rathnam: A First Course in Engineering Drawing
Brian Griffiths: Engineering Drawing for Manufacture
Er Alok Kumar Jha: Fundamentals of Engineering Drawing: A to Z of Principles of Orthographic Projection, Projections of Points & Projections of Lines
Paul Green: The Geometrical Tolerancing Desk Reference: Creating and Interpreting ISO Standard Technical Drawings
Frederick E. Giesecke: Technical Drawing with Engineering Graphics

2.12 Language II

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	3	Total	150
Responsible for the module	**Lecturer**	Ü	3	Presence	72
from Lennep-Reeder	LB Language Centre, Zinger	Pr	-	Self-study	78
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Completed level A2

Contents

- Consolidation of previous knowledge of level A2.
- Various topics from everyday life, studies and work.
- Reading and listening comprehension, speaking skills and writing training.
- Vocabulary and grammar

Qualification goal

Learners can:

- understand the main points in clear standard language when dealing with familiar topics from everyday life and the personal environment.
- simply talk about familiar topics and personal areas of interest.
- report on experiences, describe goals and plans, give brief reasons or explanations.

Usability

Compulsory module

Literature

Textbook: DaF kompakt neu B1. Course and exercise book. Stuttgart: Klett

2.13 Thermodynamics

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Till Biedermann	Prof. Dr.-Ing. Till Biedermann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Basic mathematical knowledge

Contents

- State variables of gases and vapours in systems and machines
- Equations of state, state diagrams, vapour tables
- Main laws of thermodynamics
- Changes in the state of humid air
- Presentation and consideration of circular processes:
    - Gas cycle processes and vapour cycle processes
    - Left-hand and right-hand processes
- Calculations on changes of state and selected cyclical processes with typical working media

Qualification goal

After participating in the module course, students will be able to

- name the basic thermodynamic concepts and independently formulate practical problems in the basic thermodynamic variables.
- assess energy conversions in technical processes thermodynamically. You will be able to define and determine system and balance spaces and limits.
- define and determine the efficiency of processes and components. They can also distinguish between reversible and irreversible processes.
- apply thermodynamic state diagrams to visualise processes with humid air. They can describe equations of state and vapour tables and calculate thermodynamic state variables.
- define and describe thermodynamic cycle processes in mechanical engineering machines and systems using state diagrams.
- design left-hand and right-hand circular processes. They can formulate conservation laws for individual changes of state and for complete cyclic processes. You will be able to identify and determine material data and state variables and use these to calculate cyclic processes.
- interpret and evaluate results on the basis of theoretical comparative values. They can modify input values, size or working medium to solve an energy-related problem.

Usability

Compulsory module

Literature

A. Schmidt: Technical Thermodynamics for Engineers, Springer Cham

I. Müller/ W. H. Müller: Fundamentals of Thermodynamics and Applications: With Historical Annotations and Many Citations from Avogadro to Zermelo, Springer

H.-D. Baehr / S. Kabelac: Thermodynamik - Grundlagen und technische Anwendungen, Springer Vieweg

Berlin, Heidelberg

M. C. Potter: Thermodynamics for Engineers (Schaum's Outlines), McGraw-Hill Education

A. M. Nikbakht/ A. Piri/ A. Karim: Applied Thermodynamics in Unit Operations: Solved Examples on Energy, Exergy and Economic Analyses of Processes, CRC Press

M. J. Moran/ H. N. Shapiro/ D. D. Boettner/ M. B. Bailey: Fundamentals of Engineering Thermodynamics, Wiley

2.14 Engineering Mechanics III (Kinematics and Kinetics)

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Felix Boy	Prof. Dr.-Ing. Felix Boy, Prof. Dr.-Ing. John-Glen Swanson	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mechanics I-II, Engineering Mathematics I-II

Contents

Kinematics and kinetics of point masses, point mass systems and rigid bodies:

- Geometric analysis of the movements
- Interaction of forces and movements
- Newton's axioms of mechanics
- Centre of gravity set
- Twist set
- Working set
- Energy rate
- Momentum theorem
- Impact processes.

Qualification goal

Ability to apply basic mechanical laws to technical systems, insight into the dynamic behaviour of technical systems and their analysis on the basis of basic physical laws.

Usability

Compulsory module

Literature

Hibbeler, R.C.; Engineering Mechanics: Statics

Hibbeler, R.C.; Mechanics of Materials

D. Gross et al: Engineering Mechanics 3 Springer Vieweg.

B. Assmann, P. Selke: Engineering Mechanics 3. Oldenbourg Wissenschaftsverlag.

M. Mayr: Technical Mechanics. Hanser.

C. Eller: Holzmann/Meyer/Schumpich - Engineering Mechanics - Kinematics and Kinetics. Springer Vieweg.

2.15 Machine Elements II

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	3	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	55
Prof. Dr.-Ing. Thomas Wimmer	Prof. Dr.-Ing. Thomas Wimmer, Prof. Dr.-Ing. John-Glen Swanson, Prof. Dr.-Ing. Alexander Monz	Pr	-	Self-study	95
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Mechanics I-II, Materials Science I, Machine Elements I, Engineering Design I

Contents

- Axles and shafts
- Shaft-hub connections
- Rolling bearings and rolling bearing supports
- Plain bearing
- Gear wheels and gear drives

Qualification goal

- Knowledge of the selection, characteristics and application of machine elements according to functional, calculation and engineering design principles as well as economic requirements.
- Ability to design machine elements according to the generally recognised rules of technology.

Usability

Compulsory module

Literature

Schmid/Hamrock/Jacobson: Fundamentals of Machine Elements: SI Version, CRC Press

Collins/Busby/Staab: Mechanical Design of Machine Elements and Machines (non SI), John Wiley & Sons

Roloff/Matek: Maschinen Elemente, Lehrbuch und Tabellenbuch; Wiesbaden: Vieweg

Niemann, G.: Machine Elements (Volumes 1-3); Berlin: Springer

Beitz, W. et al: Dubbel, pocket book for mechanical engineering; Berlin: Springer

2.16 Fluid Mechanics

Credit points	Proof of performance	Form of teaching	Labour input (h)

		(SWS)			
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Markus Schmid	Prof. Dr.-Ing. Markus Schmid	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Mathematics, Physics, Thermodynamics
Contents
Terminology of fluid mechanics, concept of pressure, hydrostatics, aerostatics, atmosphere, compressibility of fluids, surface tension (force effect), calculation of the load on vessel walls, steady frictionless flow, streamlines, one- and multidimensional flow, Euler equations, Bernoulli equation, outflow from vessels of different configurations, conservation of mass, momentum theorem, application of the momentum theorem to calculate forces and power, laminar and turbulent flows with internal and external flows, pressure loss calculations, pressure and velocity distributions in simple pipe systems, concept of drag and calculation of flow resistance, air forces on finite and infinitely wide aerofoils.
Qualification goal
• Knowledge of the laws of physics to describe fluids at rest and flowing fluids • Ability to apply this knowledge to the practical calculation of mechanical engineering elements and systems. • Knowledge of determining pressure and velocity distribution in simple pipework networks • Ability to determine flow-induced forces and take them into account when dimensioning components. • Ability to apply the laws of fluid mechanics to general fluid mechanics problems • Recognising flow problems with a three-dimensional character or with flows with very high velocities (gas dynamics)
Usability
Compulsory module
Literature
Kumar, Shiv: Fluid Mechanics (Vol. 1 + 2), Springer

2.17 Electrical Engineering

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
N.N.	N.N.	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Mathematics I-II, Physics

Contents
• Electrical engineering components • Direct current circuits • Magnetic field • Alternating current and three-phase current

Qualification goal
• Basic understanding of the physics of electrical components • Ability to apply the basic laws of electrical engineering to simple problems • Basic understanding of the physics and application of magnetism in power machines • Basic skills for describing AC and three-phase systems

Usability
Compulsory module

Literature
C. R. Paul, Syed A. Nasar, L. E. Unnewehr: Introduction to Electrical Engineering; McGraw-Hill Professional Ulrich Winter, Monika Burgmaier, Walter Eichler, Klaus Tkotz, Horst Bumiller: Electrical Engineering Textbook, Europa-Verlag

2.18 Language III

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	3	Total	150
Responsible for the module	**Lecturer**	Ü	3	Presence	72
from Lennep-Reeder	LB Language Centre, N.N.	Pr	-	Self-study	78
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	German			

Recommended prerequisites
Completed level B1

Contents
• Consolidation of previous knowledge of level B1 • Various topics from everyday life, studies and work. • Reading and listening comprehension, speaking skills and writing training. • Vocabulary and grammar.

Qualification goal

Learners can:

- understand the main content of texts with concrete and abstract topics.
- express themselves in such a way that a conversation is possible without major effort.
- express themselves on a wide range of topics, explain a point of view and state the advantages and disadvantages of different options.

Usability

Compulsory module

Literature

Textbook: German as a foreign language B2

2.19 Heat Transfer

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof Klaus Heying	Prof Klaus Heying	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mathematics I-II, Thermodynamics, Fluid Mechanics

Contents

- Laws of heat transfer through solid walls, fluid boundary layers and gases
- Mechanisms of heat transfer
- Heat conduction (single and multi-layer, flat, cylindrical and spherical geometry)
- Convective heat transfer (empirical equations, dimensionless key figures, influencing variables geometry, flow type and state variables of the fluid)
- Thermal radiation (physical principles, emission factors, geometry)
- Application of the laws of heat transfer using technical examples
- Types of heat exchangers. Design consideration and thermal calculation
- Use of tables for material values and state variables in the calculation of the above processes
- Process optimisation for heat utilisation

Qualification goal

- Knowledge of the laws of heat transfer
- Knowledge of the fundamentals of empirical calculation equations as well as their boundary conditions and accuracies; knowledge of the associated relevant material data and their sources.
- Ability to apply these laws in the practical calculation of different systems and apparatus.
- Ability to select the corresponding calculation equations on the basis of given boundary conditions, to derive or convert some of them and to apply them taking into account the respective problem arrangement.
- Ability to research, calculate and interpret material data and dimensionless key figures.

- Expertise in defining basic parameters for a given application in such a way that an economical and reliable device is the result of the design.
- Ability to critically interpret calculation results and, if necessary, modify them.

Usability

Compulsory module

Literature

Lienhard, J. H., V and Lienhard, J. H., IV A Heat Transfer Textbook, 6th ed. Cambridge MA: Phlogiston Press, 2024.

Introduction to Enhanced Heat Transfer, https://doi.org/10.1007/978-3-030-20740-3

Heat Transfer, https://doi.org/10.1007/978-3-030-58338-5

Böckh, P.v.: Heat Transfer - Fundamentals and Practice, Springer

Marek, R., Nitsche, Kl.: Practice of heat transfer

Polifke, W., Kopitz, J.: Heat Transfer - Fundamentals, Analytical and Numerical Methods, Pearson

Baehr, H.-D., Stephan, K.: Heat and Mass Transfer, Springer

VDI Heat Atlas (Springer)

2.20 Manufacturing Technology

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	4	Total	150
Responsible for the module	**Lecturer**	Ü	-	Presence	45
Prof. Dr.-Ing. Jan-Fabian Felderhoff	Prof. Dr.-Ing. Jan-Fabian Felderhoff, Prof. Dr.-Ing. Berthold von Großmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Materials Science I, Physics, Machine Elements I

Contents

- Chipless production
  - Casting technology
  - Sintering technology
  - Rapid prototyping process
  - Forming technology
  - Fundamentals of plastic moulding
  - Selected forming and cutting technology processes
  - Production of semi-finished products, standard parts and automotive components
- Machining production
  - Basics of chip formation

- Characteristics of the cutting edge shape
- Measurement and calculation of the cutting force
- Tool wear and tool life
- Cutting materials and coating processes
- Selected machining technology processes

Qualification goal

- Chipless production
  - Knowledge of the dominant non-cutting manufacturing processes
  - Knowledge of the production-orientated engineering design of workpieces
  - Knowledge of the process chains of (forming) manufacturing processes
  - Ability to select economical manufacturing options
- Machining production
  - Knowledge of the most important machining processes
  - Ability to select and optimise machining processes and conditions from a technical and economic point of view

Usability

Compulsory module

Literature

Serope Kalpakjian, Steven Schmid: Manufacturing Engineering and Technology, Pearson
Heinz Tschätsch, Applied Machining Technology, Springer

2.21 Numerical Methods

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Areti Papastavrou	Prof. Dr.-Ing. Areti Papastavrou, Prof. Dr-Ing. Franziska Vogel-Brinkmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mathematics I-II, Computer Science

Contents

- Numerical solution of ordinary differential equations and systems
- Numerical integration methods
- Solving linear and non-linear systems of equations
- Introduction to the MATLAB software environment
- Basics of programming and graphics in MATLAB

- User-related programming tasks

Qualification goal

- Knowledge of methods for the numerical solution of engineering problems
- Knowledge of the essential programming elements of MATLAB
- Skills in the application of numerical methods to simple calculation tasks
- Ability to programme simple numerical algorithms
- Understanding of the programme-supported application of numerical methods in engineering practice

Usability

Compulsory module

Literature

Khoury, Rachard and Harder, Douglas: Numerical Methods and Modelling for Engineers, Springer
Moin, Parviz: Fundamentals of Engineering Numerical Analysis, Cambridge University Press
Mohr, Richard: Numerical Methods in Engineering, Springer Vieweg
Stein, Ulrich: Programming with MATLAB, Hanser-Verlag

2.22 Materials Science II

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Berthold von Großmann	Prof. Dr.-Ing. Berthold von Großmann	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Materials Science I

Contents

- Structure of plastics: macromolecules, bonding forces, chain structure, effect of additives, thermoplastics, elastomers, duromers, plastic composites
- Properties of polymers: thermal, physical, chemical mechanical, electrical properties and their testing
- Mechanical behaviour of materials and material composites and its description
- Production and processing of polymers: Polycondensation, polyaddition, polymerisation, injection moulding, extrusion, thermoforming, laminating of composite materials, production-oriented design of plastic components

Qualification goal

- Overview of the relationships between the structure and properties of polymers
- Knowledge of the most important polymers, their processing methods and important technical areas of application.

- Ability to select suitable polymers and their manufacturing processes according to requirements
- Knowledge of the properties and applications of composite materials
- Knowledge of methods for describing the mechanical behaviour of materials

Usability

Compulsory module

Literature

Osswald, Materials science of polymers for engineers, Hanser Verlag, Munich

2.23 Control Engineering

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Gaby Schmitt-Braess	Prof. Dr.-Ing. Gaby Schmitt-Braess	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mathematics I + II, Physics, Electrical Engineering

Contents

- Representation methods in control engineering
- Determination of controlled system parameters
- Setup and adjustment of simple control loops
- Controls in the frequency domain and in the state space
- Design of control systems

Qualification goal

- Overview of automation systems and their use in practice
- Knowledge of the most important components of regulation and control systems
- Ability to independently solve control engineering problems in mechanical engineering, in particular controller selection and adjustment.
- Ability to communicate and present work results in a team.

Usability

Compulsory module

Literature

László Keviczky , Ruth Bars , Jenő Hetthéssy , Csilla Bányász: Control Engineering
https://doi.org/10.1007/978-981-10-8297-9

2.24 Language IV

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	4	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	65
from Lennep-Reeder	LfbA Language Centre, von Lennep-Reeder	Pr	-	Self-study	85
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	German			

Recommended prerequisites
Language I-III
Contents
• Dovetailing of specialised and language teaching • Attendance at a German-language event organised by the MB Faculty • Support in a specialised language tutorial
Qualification goal
• Language preparation for the internship semester with authentic content in the target language German Learners can: • Independently grasp and understand the vocabulary and structures of technical language • Effectively use different methods and tools to learn technical language • Express yourself on technical topics in German, ask questions and clarify misunderstandings
Usability
Compulsory module
Literature

2.25 Internship Semester

2.25.1 Supervised internship

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
22		SU	-	Total	660
Responsible for the module	**Lecturer**	Ü	-	Presence	0
Head of degree programme	Lecturer pool	Pr	-	Self-study	0
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Contents

From the areas listed below, several areas should be
can be selected:

- Development, project planning, engineering design
- Production, production preparation and control
- Assembly, operation and maintenance of machines and systems
- Testing, acceptance, production control
- Sales and consulting

Qualification goal

- Ability to work on specific engineering projects and tasks in an operational environment.
- Ability to expertly think through processes and procedures
- and problems during operation.
- Ability to develop a basis for decision-making, taking into account technical and economic aspects.
- Promotion of social skills (communication, teamwork, etc.)
- Ability to document and present work results

Usability

Compulsory module

Literature

2.25.2 Seminar for the supervised internship

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
1	Col., StA	SU	-	Total	60
Responsible for the module	**Lecturer**	Ü	-	Presence	30
Head of degree programme	Lecturer pool	Pr	-	Self-study	30
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Contents

Exchange of experience, guidance and counselling, deepening and securing knowledge, in particular through short presentations by students on their practical work, through questions and discussion, through assignments and explanations.

Qualification goal

- Ability to work on specific engineering projects and tasks in an operational environment.

- Ability to expertly think through processes and procedures
- and problems during operation.
- Ability to develop a basis for decision-making, taking into account technical and economic aspects.
- Promotion of social skills (communication, teamwork, etc.)
- Ability to document and present work results

Usability

Compulsory module

Literature

2.26 Research Methods and Scientific Writing

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Head of degree programme	N.N.	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Contents

Qualification goal

Usability

Compulsory module

Literature

2.27 Cross-cultural training

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
2	schrP 90 min	SU	2	Total	60
Responsible for the module	**Lecturer**	Ü	0	Presence	22
Head of degree programme	Sybille Kenny-Erb	Pr	-	Self-study	38

Duration	Frequency of the offer	Language
one semester	once a year	English

Recommended prerequisites

none

Contents

What is culture?

- Values and behaviours / What culture is not / Perception of self & Perception of the other / Stages of cultural awareness / Development of intercultural sensitivity

The building blocks of culture

- Dimensions of culture / Building trust / Managing intercultural teams / Relationship Orientation vs Task Orientation / Why small talk matters / Best practices - intercultural encounters /

Successful communication

- Foreign language usage - proficiency and fears / High context vs Low context / Direct vs Indirect communication styles / Non-verbal communication / Saving face

Qualification goal

Participants will gain a better understanding of what culture is and how it impacts everyday life.

Participants will understand their own culture as well as other people's cultures better, which will help them to respect cultural differences.

Participants will gain a better understanding of the cultural preferences of different countries and how they may have to adapt their behaviour during intercultural interactions in order to avoid

cultural misunderstandings and conflict.

Participants will be able to communicate more effectively across cultures, which will help them to be strong team players.

Participants will learn how to build trust across cultures, thereby improving co-operation and a productive workplace.

Participants will approach intercultural encounters with more sensitivity and understanding.

Participants will learn to recognise the symptoms of culture shock and how to deal effectively with each phase.

Usability

Compulsory module

Literature

Adler, N.J. International Dimensions of Organizational Behaviour. Cincinnati, Ohio USA: South-Western College Publishing/Thomson International Publishing

Brislin, R. Understanding Culture's influence on Behaviour. Orlando, USA: Hacourt Brace College Publishers

Gehrke, Bettina & Claes, Marie-Therese (eds.). Global Leadership Practices: A Cross-Cultural Management Perspective, Basingstoke, Hampshire, UK: Palgrave Macmillan

Hall, Edward T. Beyond culture, Garden City, New York, U.S.A.: Anchor Press/Doubleday.

Hoffmann, Hans-Erland, Schoper, Yvonne-Gabriele, Fitzsimons, Conor J. Internationales Projekt Management: Interkulturelle Zusammenarbeit in der Praxis, Munich, Germany: Deutscher Taschenbuch Verlag GmbH & Co. KG

Hofstede, G., Hofstede, G.J. & Minkov, M. Cultures and Organizations: Software of the Mind. Revised and Expanded, 3rd edition, New York: McGraw-Hill.

House, Robert J., Hanges, Paul J., Javidan, Mansour, Dorfman, Peter W. & Gupta, Vipin (eds.). Culture, Leadership and Organisations, The GLOBE Study of 62 Societies, 3rd edition, Thousand Oaks et al, CA, U.S.A.: Sage.

Kirby, Linda K., Kendall, Elizabeth & Barger, Nancy J. Type and Culture: Using the MBTI Instrument in International Applications, Mountain View, California, U.S.A.: Consulting Psychologists Press.

Lewis, R. Cross-culture Communication - a visual approach. Transcreen Publications

Marx, E. Breaking Through Culture Shock: what you need to succeed in international business. London, UK: Nicholas Brealey Publishing.

Mayer, Claude-Helene, Boness, Christian Martin. Intercultural Mediation and Conflict Resolution, Munster, Germany : Waxmann Verlag

Storti, Craig. Cross-cultural dialogues, London, UK: Nicholas Brealey Publishing

Trompenaars, Fons & Hampden-Turner, Charles. Riding the Waves of Culture: Understanding Cultural Diversity in Business, 2nd edition, London, UK: Nicholas Brealey Publishing.

2.28 Employability and Working in Germany

About vhb (OTH Regensburg/TH Rosenheim) Markus Westner, Julia Dittrich

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
2	StA	SU	2	Total	60
Responsible for the module	**Lecturer**	Ü	0	Presence	22
Head of degree programme	Prof Dr Julia Dittrich, Prof Dr Markus Westner	Pr	-	Self-study	38
Duration	**Frequency of the offer**	**Language**			
one semester	once per semester	English			

Recommended prerequisites

No specific prior knowledge or prerequisites are required to participate in the "Employability and Working in Germany" course. The course is open to all students who want to prepare for the German labour market and improve their employability.

Contents

The course offers a comprehensive introduction to the German labour market and aims to improve the employability of international students in Germany. Key topics include:

- Overview of the German labour market: sectors, professions and career paths.
- Application procedure: Preparation of CVs and cover letters, preparation for job interviews.
- Work culture and soft skills: communication, teamwork, time management and work ethics.
- Networking and professional development: building professional networks, mentoring.
- Motivation and dealing with challenges: Self-motivation, resilience.
- Project work: Creation of an application portfolio and reflection on the learning process.

Qualification goal

After completing the course, students should be able to

- To analyse the structure and dynamics of the German labour market.
- Create effective application documents according to German standards.
- Understand and adapt the work culture in Germany.

- develop and apply network strategies.
- To promote their professional development through continuous learning and self-reflection.

Usability
Compulsory module
Literature
Artess, J., Hooley, T., & Mellors-Bourne, R.: Employability: A review of the literature 2012 to 2016. Higher Education Academy, York. Research Department at the Expert Council of German Foundations on Integration and Migration. From the lecture theatre to the workplace? International students entering the labour market in Germany. Stifterverband (2022 & 2024). Various reports on educational migration and labour market integration. Yorke, M., & Knight, P.T. Embedding Employability into the Curriculum.

2.29 Numerics of Partial Differential Equations

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Franziska Vogel-Brinkmann	Prof. Dr.-Ing. Franziska Vogel-Brinkmann, Prof. Dr.-Ing. Areti Papastavrou	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Mathematics I-II, Numerical Methods, basic engineering subjects (Engineering Mechanics I-III, Machine Dynamics, Heat Transfer)

Contents

- Mathematical modelling
- Classification of partial differential equations
- Properties and characteristics of special differential equations
- Elementary solution methods
- Rooms and boundary conditions
- Numerical methods: Finite differences and finite element methods

Qualification goal

- Ability to describe and classify partial differential equations that occur in mechanical engineering
- Knowledge of elementary solution methods
- Ability to apply numerical methods to solve simple partial differential equations

Usability

Compulsory module

Literature
Arendt, Urban: Partial Differential Equations - An Introduction to Analytical and Numerical Methods, Springer
Arendt, Urban: Partial Differential Equations - An Introduction to Analytical and Numerical Methods, Springer Spektrum
Lynch, Daniel: Numerical Partial Differential Equations for Environmental Scientists and Engineers, Springer
Logan, J. David: Applied Partial Differential Equations, Springer
Van Kal, Segal, Vermolen: Numerical Methods in Scientific Computing, TU Delft Open
Kaltenbacher, Manfred: Numerical simulation of mechatronic sensors and actuators: finite elements for computational multiphysics
Quarteroni, Alfio and Valli, Alberto: Numerical Approximation of Partial Differential Equations, Springer

2.30 Finite Element Analysis

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Franziska Vogel-Brinkmann	Prof. Dr.-Ing. Franziska Vogel-Brinkmann, Prof. Dr.-Ing. Areti Papastavrou	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Mathematics I-II, Numerical Methods, basic engineering subjects (Engineering Mechanics I-III, Machine Dynamics, Heat Transfer)

Contents

- Basic equations and boundary conditions for calculation tasks in structural mechanics and heat conduction, analytical solutions for simple cases, energy principles.
- Carrying out FEM calculations in the field of structural mechanics and temperature field analysis with a commercial FEM software programme: transfer of CAD geometry, material data, meshing, loads and boundary conditions, control of the calculation process, different types of analysis, evaluation and assessment of the results, comparison of the results with analytical rough calculations

Qualification goal

- Skills in the practical application of the finite element method (FEM) to problems in mechanical engineering.
- Ability to critically assess FEM analyses.
- Familiarity with the possible applications of FEM in component development.

Usability

Compulsory module

Literature
Chr. Gebhardt: Practical book FEM with ANSYS Workbench. Hanser-Verlag.
B. Klein: FEM - Grundlagen und Anwendungen der Finite-Element-Methode im Maschinen- und Fahrzeugbau. Springer Vieweg.
Wriggers, Peter: Nonlinear Finite Element Methods, Springer
Wriggers, Peter: Nonlinear Finite Element Analysis, Springer
Saeed, Moaveni: Finite element analysis: theory and application with Ansys
Hughes, Thomas J.: The finite element method: linear static and dynamic finite element analysis, Dover Publications

2.31 Engineering Design III

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	StA	SU	-	Total	150
Responsible for the module	**Lecturer**	Ü	4	Presence	45
Prof. Dr.-Ing. Thomas Wimmer	Prof Dr Alexander Monz, Prof Dr Thomas Wimmer	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites
Engineering Design I-II; Engineering Mechanics I-III; Materials Science I; Machine Elements I-II; Manufacuring Technology

Contents

- Introduction to GPS (Geometric Product Specifications)
- Methodical breakdown of the unstructured task into small work packages (specifications, interface definition, work package description, ...)
- Presentation of the idea-finding processes and practical practice in individual and group work
- Use presentation techniques to present the solutions developed for the engineering design project
- Integration of complex machine elements (gears, couplings, bearings, ...) into an engineering design project, e.g. gearboxes
- Presentation of the integration of the engineering design process into the entire life cycle process and the associated interdisciplinary product development
- Creation of various technical documents (specifications, individual part drawings, assembly drawings, assembly descriptions, operating instructions, etc.) and practical demonstration of the possibilities for computer-aided management of these documents

Qualification goal

- Ability to methodically develop solution variants for complex engineering design projects in group work
- Competent presentation of technical solutions

- Ability to implement the knowledge from the basic modules using the example of a complex engineering design task
- Recognising the advantages and disadvantages of independent individual work compared to teamwork
- Ability to work on an unstructured task with the aim of creating production-ready assemblies
- Skills in the creation of technical product documentation and in the calculation of gear-related machine elements
- Ability to apply the "Geometric Product Specification" (GPS) to complex machine elements
- Recognising that design is an interdisciplinary process that is carried out using the methods of simultaneous engineering and concurrent engineering

Usability

Compulsory module

Literature

Schmid/Hamrock/Jacobson: Fundamentals of Machine Elements: SI Version, CRC Press

Collins/Busby/Staab: Mechanical Design of Machine Elements and Machines (non SI), John Wiley & Sons

Mechanical and Metal Trades Handbook, Europa-Lehrmittel

Ribbens: Simultaneous Engineering for New Product Development, Wiley & Sons

Roloff/Matek: Machines Elements, Vieweg

Ehrlenspiel: Integrated Product Development, Hanser

2.32 Machine Dynamics

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof. Dr.-Ing. Felix Boy	Prof. Dr.-Ing. Felix Boy	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mechanics I-III, Engineering Mathematics I-II

Contents

Modelling of vibrating mechanical systems, fundamentals of vibration technology, vibrations with one and more degrees of freedom, free and forced vibrations, damped vibrations, setting up and solving the equations of motion, vibration damping.

Qualification goal

Knowledge of the interactions of forces and movements in vibration systems, ability to solve machine dynamics problems using mathematical methods, insight into the dynamic design of machines.

Usability

Compulsory module

Literature

Hibbeler, R.C.; Engineering Mechanics: Dynamics

H. Dresig, F. Holzweißig: Machine Dynamics. Springer-Verlag.

R. Gasch, K. Knothe, R. Liebich: Structural Dynamics. Springer Vieweg.

D. Gross et al: Engineering Mechanics 3 Springer Vieweg.

M. Knaebel, H. Jäger, R. Mastel: Technische Schwingungslehre. Teubner-Verlag.

2.33 Mechatronics

Credit points	**Proof of performance**	**Form of teaching (SWS)**		**Labour input (h)**	
5	schrP 60 min, StA	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü		Presence	45
Prof. Dr.-Ing. Gaby Schmitt-Braess	N. N.	Pr	2	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mathematics I-II, Engineering Mechanics III, Control Engineering, Numerical Methods

Contents

- Actuators and sensors
- Modelling of multi-body systems (kinematics and kinetics)
- Description options for mechatronic systems (linearisation, state space representation, Laplace transformation, transfer function, frequency response)
- Control of mechatronic systems
- Simulation of dynamic systems
- Working with the MATLAB/Simulink software package and in particular with the toolboxes "Control System Toolbox", "Symbolic Math Toolbox", "Simulink Control Design"

Qualification goal

- Acquisition of knowledge about the interaction of electrical engineering, information technology and mechanical engineering using selected examples
- Knowledge of selected sensors and actuators in mechatronics
- Ability to abstract and describe mechatronic subsystems and integrated systems (consisting of drives, machines, sensors and regulation/control systems)
- Ability to specifically influence mechatronic systems through control engineering measures
- Acquisition of knowledge in the field of dynamics simulation
- Ability to use MATLAB/Simulink and selected toolboxes to solve problems from the above-mentioned areas

Usability

Compulsory module

Literature

Introduction to Mechatronics, https://doi.org/10.1007/978-3-031-29320-7

2.34 Data Science

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
5	schrP 90 min, StA	SU	2	Total	150
Responsible for the module	**Lecturer**	Ü	2	Presence	45
Prof Dr Benjamin Menz	Prof Dr Benjamin Menz	Pr	-	Self-study	105
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English			

Recommended prerequisites

Engineering Mathematics I (linear algebra),
Computer Science (control structures, data types, operations)

Contents

- Data science terms, categorisation and history (data mining, data science, analytics, machine learning, artificial intelligence)
- Role of data science in industrial processes and future business scenarios (use cases, digitalisation, I 4.0)
- Fundamentals of mathematics (matrices, vectors), statistics (distributions, moments) and programming (R, Python libraries)
- Process models for data science projects (KDD, CRISP-PM, DASC-PM v1.0)
- Data types, data sources, data quality, data preparation
- Basic methods (supervised, unsupervised semi-supervised, reinforcement learning, ...) and their characteristics and fields of application
- Realisation of a data science project for selected questions from mechanical engineering

Qualification goal

- Knowledge of potential fields of application in mechanical engineering and relevant methods for gaining knowledge from data
- Understanding the preparation of data for analysis and the differences and application limits of the various methods
- Selection and application of suitable data science methods for given questions and available data bases / qualities
- Evaluating and assessing processes with the inclusion of domain expertise
- Independent processing of a data science project incl. validation

Usability

Compulsory module

Literature

O'Reilly: Introduction to Data Science,Joel Gruns

O'Reilly: Introduction to Machine Learning with Python

2.35 15 ECTS (3x subject) from catalogue (online & asynchronous lecture)

2.36 Bachelor thesis

2.36.1 Bachelor thesis

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
12	Bachelor thesis	SU	-	Total	360
Responsible for the module	**Lecturer**	Ü	-	Presence	0
Head of degree programme	Lecturer pool	Pr	-	Self-study	360
Duration	**Frequency of the offer**	**Language**			
max. 6 months	once a year	English or German			

Recommended prerequisites
All 120 LP from the first 4 semesters completed. Successful completion of the practical part of the practical semester and proven participation in a field trip lasting several days or, alternatively, three one-day excursions. Corresponding excursions are offered by the faculty as part of the excursion week of the 4th semester.

Contents
Independent scientific work, e.g. solving technical and scientific tasks, new and further development of technical and organisational systems in the fields of mechanical engineering.

Qualification goal

The Bachelor's thesis should demonstrate the ability to carry out independent scientific work, especially the independent scientific solution of a problem in the field of mechanical engineering.

Further learning objectives/outcomes are (depending on the topic):

- Ability to analyse and find solutions
- Ability to apply scientifically sound methods
- Ability to carry out research
- Ability to select and apply suitable analysis, modelling, simulation and optimisation methods
- Ability to plan, implement and control processes and systems
- Ability to deepen knowledge
- Recognising the scope of engineering activities
- Ability to document and present work results.
- Promotion of social skills (e.g. communication, teamwork, etc.)

Usability
Compulsory module

Literature
Task-specific literature

2.36.2 Bachelors' seminar with project discussions and final presentation

Credit points	Proof of performance	Form of teaching (SWS)		Labour input (h)	
3	Final presentation Participants in 11 lectures	SU	-	Total	90
Responsible for the module	**Lecturer**	Ü	-	Presence	15
Head of degree programme	Lecturer pool	Pr	-	Self-study	75
Duration	**Frequency of the offer**	**Language**			
one semester	once a year	English or German			

Recommended prerequisites

Contents

Students present the status of their work during the processing period in presentations, discussions or talks. Students take part in final presentations of other students' Bachelor's theses. At the end of the Bachelor's thesis, students give a presentation on their own topic and take part in a discussion. This trains the students' ability to present, discuss and speak freely about a topic.

Qualification goal

The Bachelor's seminar is intended to train the ability to present, introduce and discuss an independent scientific paper.

The aims of the Bachelor's seminar are:

- Ability to conduct a technical discussion
- Competence to lead a discussion.
- Ability to present work results

Usability

Compulsory module

Literature