OTH REGENSBURG

Module handbook

International Mechanical Engineering (B.Eng.)

undergraduate programme

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Faculty of mechanical engineering

Module list

Study level 1:

Study level 2:

Study level 3:

Module title	Module code
Design of machine elements 1 (Maschinenelemente 1)	eME1

Person responsible for the module	Faculty
Prof. Dr. Andreas Wagner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
2	1	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Design of machine elements 1 (Maschinenelemente 1)	4 SWS	5

Submodule	Submodule abbreviation
Design of machine elements 1 (Maschinenelemente 1)	**eME1**

Responsible person	Faculty
Prof. Dr. Andreas Wagner	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Andreas Wagner	only in summer semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 hours	90 hours

Method of assessment
Written exam 120 minutes
Approved Aids for Evidence of Achievement
• SHM (Standard tools, page 2) • All handwritten and printed documents supplied by the lecturer (no solved exercises)

Content
• Tolerances and fits, in-depth study • Pre-dimensioning and strength verification of components subjected to time-stationary and time-instationary stress • Screw connections, fundamentals and calculation • Fundamentals and arrangement of rolling bearings, pre-dimensioning and life span calculation • Calculation of welded connections • Calculation of form-fit and material-fit shaft/hub connections
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • select the correct machine elements for the respective application (2) and know their design (1) • pre-dimension and size machine elements (3) • create strength verifications with life span estimation (2) and assess existing safety factors (3) • recognize damage patterns and derive causes of failure (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • specify terminology, nomenclature and parameters of machine elements (1) • handle data sheets and catalogue material (2) • know the historical background and the necessity of machine elements and standards (1) • apply specialist knowledge and methodical knowledge for safe and standard-compliant action in industry (3) • guide product development (3)
Teaching materials offered
Lecture handout
Teaching media
Computer projector, digital blackboard
Literature
Roloff/Matek Maschinenelemente - Lehrbuch und Tabellenbuch, Vieweg Verlag

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Engineering Design 1 (Konstruktion 1)	eKO1

Person responsible for the module	Faculty
Prof. Dr. Tobias Laumer	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
1	1	mandatory	5

Mandatory requirements
None
Recommended previous knowledge
None

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Engineering Design 1 (Konstruktion 1)	4 SWS	5

Submodule	Submodule abbreviation
Engineering Design 1 (Konstruktion 1)	**eKO1**

Responsible person	Faculty
Prof. Dr. Tobias Laumer	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Tobias Laumer	only in winter semester

Teaching method

- Seminar teaching (SU)
- Practical course (Pr)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Portfolio exam
Approved Aids for Evidence of Achievement
SHM (Standard Tools, page 2)

Content

Basics of the engineering process:

- basic design process for new products; product life cycle, sustainability
- additive Manufacturing as tool in the engineering process

Basics of engineering drawings:

- presentation principles and sectional views
- dimensioning, threads and surfaces
- limits and fits
- turning workpieces and standard parts
- tolerances of geometry, orientation, location and runout

Basics of Computer Aided Design (CAD):

- designing of single parts
- creating assemblies of multiple parts
- derivation of engineering drawings from single parts and assemblies conforming to standards

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • know the meaning of technical standards for the designing process (2) • design mechanical parts and assemblies as virtual 3D models (2) • deviate engineering drawings from 3D parts and assemblies conforming to up-todate standards (2) • read and understand complex engineering drawings containing limits, surface properties and tolerances of geometry, orientation, location and runout (3) • evaluate the potential and limitations of CAD systems (3) • know important standard parts and their application for parts and assemblies (2)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • quickly understand complex engineering drawings (2) • know the responsibility of the designer within the design process for functionality, manufacturability and costs of designed parts (2) • communicate within and without a company about single parts and assembly groups with the help of engineering drawings and CAD designs (3)
Teaching materials offered
Lecture handout, video units
Teaching media
Computer/projector, blackboard, CAD workstation
Literature
Oesterlie, S., et al.: Mechanical and Metal Trades Handbook, Europa Lehrmittel.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Engineering Mechanics 1 (Technische Mechanik)	eTM1

Person responsible for the module	Faculty
Prof. Dr. Valter Böhm	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
1	1	mandatory	5

Mandatory requirements
None
Recommended previous knowledge
None

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Engineering Mechanics 1 (Technische Mechanik 1)	4 SWS	5

Submodule	Submodule abbreviation
Engineering Mechanics 1 (Technische Mechanik 1)	**eTM1**

Responsible person	Faculty
Prof. Dr. Valter Böhm	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr.-Ing. Florian Bauer Prof. Dr. Valter Böhm Prof. Dr. Fredrik Borchsenius Prof. Dr. Ulrich Briem Prof. Dr. Ingo Ehrlich Prof. Dr. Aida Nonn Prof. Dr. Ulrike Phleps	only in winter semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written examination, 120 minutes. The eTM1 module is examined in the same way in the MB, BE, DEM, IME and NEW degree programmes. The module is mutually recognised.
Approved Aids for Evidence of Achievement
• Standard tools (see page 2) • All handwritten and printed documents

Content
Tasks and categorisation of mechanics: • forces and their representation, basic axioms and principles • centres of gravity and resultants of distributed forces • support reactions and member forces in truss and load-bearing structures • internal forces in beams, frames and arches • laws of friction • stresses, deformations and material laws

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • calculate centres of gravity and resultants of distributed forces (3), • calculate forces and moments on statically determinate systems (3), • calculate support forces and member forces for trusses and supporting structures (3), • calculate and graphically visualise internal reactions (normal and shear force, bending and torsional moment) (3), • calculate static and dynamic friction forces in mechanical systems (3), • know the basic concepts of elastostatics (1), • form simple mechanical models from technical systems (2).
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • recognise the importance of mechanics in all disciplines of mechanical engineering (1), • recognise the importance of mechanics to the sustainability of engineering activities (1), • clearly describe mechanical problems (2), • find solutions to difficult tasks in a team (3).
Teaching materials offered
Script, formulary
Teaching media
Blackboard, overhead, computer/beamer
Literature
See script

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Engineering Mechanics 2 (Technische Mechanik 2)	eTM2

Person responsible for the module	Faculty
Prof. Dr. Aida Nonn	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
2	1	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Engineering Mechanics 2 (Technische Mechanik 2)	4 SWS	5

Submodule	Submodule abbreviation
Engineering Mechanics 2 (Technische Mechanik 2)	**eTM2**

Responsible person	Faculty
Prof. Dr. Aida Nonn	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Valter Böhm Prof. Dr. Fredrik Borchsenius Prof. Dr. Ulrich Briem Prof. Dr. Ingo Ehrlich Prof. Dr. Aida Nonn	**every semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written examination, 120 minutes Module eTM2 is assessed in the same way in the MB, DEM and BE programmes. The module is mutually accepted.
Approved Aids for Evidence of Achievement
• Standard aids (see page 2) • All handwritten and printed documents

Content
• Bending, shearing and torsion in straight members • Buckling behaviour of members • Multi-axial stresses and resulting deformations • Thin-walled hollow structures under internal and external pressure • Superposition of stress components and calculation of equivalent stress • Analysis of statically indeterminate systems
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • calculate stresses and deformations in straight members (Level 3) • analyse members susceptible to buckling (Level 3) • determine stresses and strains in thin-walled hollow structures (Level 3) • design and dimension basic machine components (Level 3)

- calculate stresses and deformations under combined loading conditions (Level 3)
- solve statically indeterminate systems (Level 3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • understand the importance of mechanics in all areas of mechanical engineering (Level 1) • articulate mechanical problems clearly (Level 2) • work effectively in teams to solve complex problems (Level 3)
Teaching materials offered
Script, formula collection
Teaching media
Board, overhead, computer/projector
Literature
See script

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Fundamentals of Programming (Grundlagen der Programmierung)	eGPR

Person responsible for the module	Faculty
Prof. Dr. Peter Gschwendner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
2	1	mandatory	5

Mandatory requirements
None
Recommended previous knowledge
None

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Fundamentals of Programming (Grundlagen der Programmierung)	4 SWS	5

Submodule	Submodule abbreviation
Fundamentals of Programming (Grundlagen der Programmierung)	**eGPR**

Responsible person	Faculty
Prof. Dr. Peter Gschwendner	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Valter Böhm Prof. Dr. Fredrik Borchsenius Prof. Dr. Peter Gschwendner Prof. Dr. Oliver Webel	**every second semester
Teaching method	
Seminar-style / Instruction	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 minutes
Approved Aids for Evidence of Achievement
Standard Tools, Script with handwritten addition

Content

- Number representation, binary, hexadecimal, floating-point numbers (1)
- Variables, arrays, structures (3)
- Loops (3)
- Conditional branches (3)
- Subprogram techniques (2)
- Global and local data (2)
- Recursive function calls (1)
- Application of simple optimization methods (2)
- Classes and objects (1)
- Simple user interfaces (2)
- Applications, interfaces, databases, creation of own function libraries (3)

All content is developed using Matlab.

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- understand algorithmic approaches in mathematics. (2)

- recognize algorithmics as a tool for solving scientific, technical, or mathematical problems. (3)
- create simple application programs to solve scientific, technical, or mathematical problems. (3)
- recognize algorithmics as the foundation of computer software. (3)
- understand macro techniques for program control. (3)
- learn software development. (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- recognize the importance of programming and the associated difficulties for mechanical engineering. (2)
- assess the advantages and disadvantages of modern computer solutions in mechanical engineering. (3)
- find innovative solutions for challenging tasks in mechanical engineering. (3)

Teaching materials offered

MatLab, Script

Teaching media

Overhead projector, blackboard, CAD workstation for each participant, calculation programs, exhibits, computer/projector, internet

Literature

Script, Internet help, “stack overflow”, AI, chatGpt

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A/B 1	LTA/B1

Person responsible for the module	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	

Semester taught according to the curriculum	Level of study	Module type	Credit value
1	1	mandatory	5

Mandatory requirements
LTA1: German at level A2.2 LTB1: English at level B1.2

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A 1 (German as a Foreign Language B1.1)	4 SWS	5
2.	Language Track B1 - (Business English 1)	2 SWS	2.5
3.	Language Track B1 - (Technical English 1)	2 SWS	2.5

Submodule	Submodule abbreviation
Language Track A 1 (German as a Foreign Language B1.1)	**LTA 1**

Responsible person	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	
Lecturer	**Availability of module**
Daniela Dechant (LB) Lucie Eireiner (LBA)	**every semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60	90

Method of assessment
see study plan AW
Approved Aids for Evidence of Achievement
see study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW

Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B1 - (Business English 1)	**LTB1**

Responsible person	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	
Lecturer	**Availability of module**
Joanne Gibson	only in winter semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	2 SWS	english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan AW
Approved Aids for Evidence of Achievement
See study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW
Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B1 – (Technical English 1)	**LTB1**

Responsible person	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	
Lecturer	**Availability of module**
Sarah O´Sullivan (LBA)	only in winter semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	2 SWS	english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan AW
Approved Aids for Evidence of Achievement
See study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW
Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A/B 2	LTA/B 2

Person responsible for the module	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	

Semester taught according to the curriculum	Level of study	Module type	Credit value
2	1	mandatory	5

Mandatory requirements
LTA1: German at level B1.1 LTB1: English at level B 2

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A 2 (German as a Foreign Language B1.2)	4 SWS	5
2.	Language Track B2 - (Business English 2)	2 SWS	2.5
3.	Language Track B2 - (Technical English 2)	2 SWS	2.5

Submodule	Submodule abbreviation
Language Track A 2 (German as a Foreign Language B1.2)	**LTA 2**

Responsible person	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	
Lecturer	**Availability of module**
Lucie Eireiner (LBA) Christine König (LBA) Sheryl Schneider (LBA)	**every semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
see study plan AW
Approved Aids for Evidence of Achievement
see study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW

Teaching media
See module handbook AW
Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B2 - (Business English 2)	**LTB2**

Responsible person	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	
Lecturer	**Availability of module**
Sarah O´Sullivan (LBA)	only in winter semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	2 SWS	english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan AW
Approved Aids for Evidence of Achievement
See study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW
Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B2 - (Technical English 2)	**LTB2**

Responsible person	Faculty
Prof. Dr. Katherine Gürtler Christine König (LBA)	
Lecturer	**Availability of module**
Sarah O´Sullivan (LBA)	only in summer semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	2 SWS	english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan AW
Approved Aids for Evidence of Achievement
See study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW
Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Manufacturing Methods (Fertigungsverfahren)	eFV

Person responsible for the module	Faculty
Prof. Dr. Andreas Ellermeier	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
1	1	mandatory	4

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Manufacturing Methods (Fertigungsverfahren)	4 SWS	5

Submodule	Submodule abbreviation
Manufacturing Methods (Fertigungsverfahren)	**eFV**

Responsible person	Faculty
Prof. Dr. Andreas Ellermeier	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Andreas Ellermeier Prof. Dr. Wolfram Wörner	only in winter semester
Teaching method	
Seminaristic teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, multiple-choice, 90 Min.
Approved Aids for Evidence of Achievement
SHM (standard tools, page 2)

Content

- Overview of manufacturing processes
- Casting and Forming processes as well as process-related materials engineering fundamentals
- Machining processes and process-related fundamentals
- Joining processes and process-related fundamentals
- Production processes for coating and process-related fundamentals
- Additive manufacturing processes
- Polymer processing and process-related materials engineering principles
- Design guidelines for specific production processes

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- Correctly apply fundamental technical terminology (1)
- describe the relevant manufacturing processes (1) and compare them regarding the achievable component properties and quality (3)
- evaluate the relationships between material, manufacturing process and resulting component properties (3)
- assess manufacturing processes in terms of their advantages and limitations (2)
- select manufacturing processes based on the construction material (2)

- design component geometry for production (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
- participate in the technical and economic design of production processes (2)
- successfully discuss with manufacturing experts (3)

Teaching materials offered

Lecture handout

Teaching media

Computer/projector, Blackboard, showpieces

Literature

Awiszus, Birgit; Bast, Jürgen; Dürr, Holger; Mayr, Peter: Fundamentals of production engineering. 6th edition. Carl Hanser Verlag, Munich, 2016.
eISBN: 978-3-446-44821-6, Print ISBN: 978-3-446-44779-0

More information about the course

Assistance with the new formulation:
- Knowing (level 1) - e.g. naming, specifying, labeling, enumerating
- Ability (level 2) - e.g. use, execute, handle, select, construct, calculate, create, examine, build, design, plan, elaborate, compile
- Understanding and applying (level 3) - e.g. developing, analyzing, assessing, weighing, checking, criticizing, evaluating, evaluating, weighting, interpreting, estimating, recommending, suggesting, presenting, showing
- These levels are added in brackets after the competencies.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Material Science (Werkstofftechnik)	eWTK

Person responsible for the module	Faculty
Prof. Dr. Ulf Noster	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
1	1	mandatory	6

Mandatory requirements
None
Recommended previous knowledge
None

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Laboratory Exercises: Material Science (Werkstofftechnikpraktikum)	1 SWS	1
2.	Material Science (Werkstofftechnik)	4 SWS	4

Submodule	Submodule abbreviation
Laboratory Exercises: Material Science (Werkstofftechnikpraktikum)	**eWTKP**

Responsible person	Faculty
Prof. Dr. Ulf Noster	mechanical engineering
Lecturer	**Availability of module**
Andreas Hüttner Prof. Dr. Ulf Noster Dr. Reinhard Sangl (LBA) Prof. Dr. Wolfram Wörner	only in winter semester

Teaching method
Laboratory Exercises (Pr)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	1 SWS	english	1

Study hours required

Hours in attendance/lectures	Hours for self-study
15ch	30 h

Method of assessment
Attendance (TN) and practical assessment (prLN)
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Conducting laboratory tests for materials testing and manufacturing technology (e.g. tensile tests, impact tests, hardness tests, joining technology tests)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- apply the methods and procedures shown in the laboratory exercise in a technically correct manner (2),
- to record and document the experiments carried out in the laboratory exercise (2),
- interpret the results of the experiments carried out in the laboratory exercise (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- carry out experiments independently in small groups under supervision in the laboratory (2),
- to answer questions in the laboratory course independently in small groups (3).

Teaching materials offered
Lecture handout, ELO online course
Teaching media
Laboratory test machines, specimen, whiteboard
Literature
Material Science and Engineering, Callister, Wiley-VCH

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Material Science (Werkstofftechnik)	**eWTKV**

Responsible person	Faculty
Prof. Dr. Ulf Noster	mechanical engineering
Lecturer	**Availability of module**
Andreas Hüttner Prof. Dr. Ulf Noster Dr. Reinhard Sangl (LBA) Prof. Dr. Wolfram Wörner	only in winter semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	4 SWS	english	4

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 min
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Structure of materials: Metals, plastics, ceramics
- Mechanical properties of materials
- Selected physical and chemical properties of materials
- Materials testing
- Fundamentals of alloy formation, phase diagrams
- Heat treatment of steels
- Time-temperature transformation diagrams
- Standardized material designation
- Material cycles

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- understand influences of the structure and special features of materials on applications (2),
- describe the effects of the basic properties of materials on products and processes (1),
- consider holisticly of the consequences of material selection with a focus on sustainability (2),
- link structure with material properties (2).

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • realistically assess their own level of knowledge in relation to the subject area (3), • interact successfully with materials experts in interdisciplinary teams (2), • describe the consequences of material selection for people and the environment (1).
Teaching materials offered
Lecture handout, ELO online course
Teaching media
Computer/projector, blackboard
Literature
Material Science and Engineering, Callister, Wiley-VCH

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Mathematics for Engineers 1 (Ingenieurmathematik 1)	eMA1

Person responsible for the module	Faculty
Prof. Dr. Jan-Philipp Weiß	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
1	1	mandatory	5

Mandatory requirements
None
Recommended previous knowledge
Pre- and bridge courses mathematics

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Mathematics for Engineers 1 (Ingenieurmathematik 1)	4 SWS	5

Submodule	Submodule abbreviation
Mathematics for Engineers 1 (Ingenieurmathematik 1)	**eMA1**

Responsible person	Faculty
Prof. Dr. Jan-Philipp Weiß	Computer Science and Mathematics
Lecturer	**Availability of module**
Dr. Doris Augustin Dr. Gabriela Tapken (LBA) Prof. Dr. Stefanie Vogl Prof. Dr. Jan-Philipp Weiß	only in winter semester

Teaching method
Seminar teaching with exercises

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
1	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 Min.
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), published formulary

Content

The students are aware of and understand the mathematical formalism and have basic knowledge of the mathematical concepts, calculation rules and solution methods within the following areas:

- numbers and functions: recap of power functions and logarithmic functions, solution of equations and inequalities, function definitions, elementary functions and their properties
- complex numbers: representation of complex numbers, complex calculus, complex exponential function and Euler's formula, complex representation of harmonic oscillations
- series, limits and convergence, continuous functions
- differential calculus: notion of and techniques for derivatives, L'Hopital's rule, curve sketching, extreme values in the presence of constraints, Newton's method
- integral calculus in one dimension: definite and indefinite integrals, fundamental theorem of calculus, integration techniques (partial integration, substitution rule, integration by means of expansions into partial fractions)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- to identify suitable methods and solution concepts in the fields mentioned above (1)

- to apply the studied mathematical methods successfully to the solution of problems and to interprete and to discuss the solutions (2)
- to explain the scientific contents dealt with in the lecture (2)
- to give mathematical formulations of simple problems and to analyze them (2 and 3)
- to read and to understand further mathematical texts in a self-reliant manner (3)
- to analyze and to structure complex correlations and to develop solution approaches (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- to explain and to communicate the mathematical content in oral and in written form using appropriate technical terms (2)
- to work on and to solve mathematical problems in a self-reliant way as well as in work teams (3)
- to discuss and to critically dispute their compiled solutions and check for plausibility (2)

Teaching materials offered

Blackboard sketches, lecture slides, exercises

Teaching media

Blackboard, beamer and slides

Literature

- C. Karpfinger, Höhere Mathematik in Rezepten, 3. Auflage, Springer Spektrum, 2017.
- L. Papula, Mathematische Formelsammlung, 12. Auflage, Springer Vieweg, 2017.
- L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 1, 15. Auflage, Springer Vieweg, 2018.
- L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 2, 14. Auflage, Springer Vieweg, 2015.
- Y. Stry, R. Schwenkert, Mathematik kompakt: für Ingenieure und Informatiker, 4. Auflage, Springer-Verlag Berlin Heidelberg, 2013.
- A. Croft, & R. Davison, Mathematics for engineers: a modern interactive approach. Pearson Education, 2009

More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Mathematics for Engineers 2 (Ingenieurmathematik 2)	eMA2

Person responsible for the module	Faculty
Prof. Dr. Jan-Philipp Weiß	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
2	1	mandatory	5

Mandatory requirements
None
Recommended previous knowledge
eMA1

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Mathematics for Engineers 2 (Ingenieurmathematik 2)	4 SWS	5

Submodule	Submodule abbreviation
Mathematics for Engineers 2 (Ingenieurmathematik 2)	**eMA2**

Responsible person	Faculty
Prof. Dr. Jan-Philipp Weiß	Computer Science and Mathematics
Lecturer	**Availability of module**
Dr. Doris Augustin Dr. Gabriela Tapken (LBA) Prof. Dr. Stefanie Vogl Prof. Dr. Jan-Philipp Weiß	only in summer semester

Teaching method
Seminar teaching with exercises

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 Min.
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), published formulary

Content
The students are aware of and understand the mathematical formalism and have basic knowledge of the mathematical concepts, calculation rules and solution methods within the following areas: • linear algebra: vector calculus, bases und coordinate systems, orthogonality, matrices and linear mappings, determinants and matrix ranks, linear systems of equations (Gaussian elimination, solvability, structure of solutions), inverse matrix, eigenvalues and eigenvectors, diagonalization of matrices • infinite series of numbers: definition and examples of important series, convergence criteria • power series and Taylor series: convergence behavior, calculation rules for power series, power series expansion of functions, Taylor series and local approximations, Taylor's theorem, application examples • Fourier series: Fourier series for periodic functions, convergence behavior and properties • Integral calculus in one dimension: definite and indefinite integrals, fundamental theorem of calculus, integration techniques (partial integration, substitution rule, integration by means of expansions into partial fractions)

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • to identify suitable methods and solution concepts in the fields mentioned above (1) • to apply the studied mathematical methods successfully to the solution of problems and to interpret and to discuss the solutions (2) • to explain the scientific contents dealt with in the lecture (2) • to give mathematical formulations of simple problems and to analyze them (2 and 3) • to read and to understand further mathematical texts in a self-reliant manner (3) • to analyze and to structure complex correlations and to develop solution approaches (3)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • to explain and to communicate the mathematical content in oral and in written form using appropriate technical terms (2) • to work on and to solve mathematical problems in a self-reliant way as well as in work teams (3) • to discuss and to critically dispute their compiled solutions and check for plausibility (2)
Teaching materials offered
Blackboard sketches, lecture slides, exercises
Teaching media
Blackboard, beamer and slides
Literature
• C. Karpfinger, Höhere Mathematik in Rezepten, 3. Auflage, Springer Spektrum, 2017. • L. Papula, Mathematische Formelsammlung, 12. Auflage, Springer Vieweg, 2017. • L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 1, 15. Auflage, Springer Vieweg, 2018. • L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 2, 14. Auflage, Springer Vieweg, 2015. • Y. Stry, R. Schwenkert, Mathematik kompakt: für Ingenieure und Informatiker, 4. Auflage, Springer-Verlag Berlin Heidelberg, 2013. • A. Croft, & R. Davison, Mathematics for engineers: a modern interactive approach. Pearson Education, 2009.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Thermodynamics 1 (Thermodynamik 1)	eTD1

Person responsible for the module	Faculty
Prof. Dr. Belal Dawoud	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
2	1	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Thermodynamics 1 (Thermodynamik 1)	4 SWS	5

Submodule	Submodule abbreviation
Thermodynamics 1 (Thermodynamik 1)	**eTD1**

Responsible person	Faculty
Prof. Dr. Belal Dawoud	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Belal Dawoud Prof. Dr. Johannes Eckstein Prof. Dr. Robert Leinfelder Prof. Dr. Andreas Lesser Prof. Dr. Thomas Lex Prof. Dr. Christian Rechenauer	**every year

Teaching method
Seminaristischer Unterricht und Übung

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
2	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 min
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), Recently published formulary (with hand-written additions) and steam tables in the ELO course

Content
• Introduction and basic definitions • Energy conversion and first law of Thermodynamics • Second law of Thermodynamics • Ideal gases and ideal gas mixtures • Pure substances and their phase change processes • Standard Thermodynamic cycles
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • explain the fundamental definition of the thermodynamic science (1) • carry out mass and energy balances of different thermodynamic systems (2)

- evaluate different thermodynamic processes from the perspective of the second law of thermodynamics (2)
- estimate the maximum possible work yield of heat and of an enthalpy stream (3)
- estimate the properties of ideal gases and gas-mixtures (2) and evaluate the basic thermodynamic processes (3)
- estimate the properties of the different phases of pure substance (2) and evaluate the basic phase-change processes (3)
- evaluate the efficiency of standard thermodynamic cycles with ideal gases and with phase-changing pure substances (3)
- identify the weak points of standard cycles (3) and assess the improvement measures of their efficiencies (3)
- analyze the deviations from the standard cycles and assess the performance of real energy transition cycles (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- describe (1) and analyze (3) the consequences of heat to power energy conversion systems on the environmental global warming,
- acquire the fundamentals and key performance indicators of energy conversion processes (1)
- work with property tables of different substances to evaluate energy processes and conversion cycles (1)
- identify and exercise the basic principles of teamwork and feedback rules (2)
- develop the increasing importance of thermal energy and energy efficiency in a professional self-image (3)

Teaching materials offered

Script, Formulary, Collection of Exercises

Teaching media

z.B. Rechner/Beamer, Tafel

Literature

Yunus Cengel, Michael A. Boles and Mehmet Kanoglu; THERMODYNAMICS, an Engineering Approach, 9th Edition in SI, McGraw-Hill, 2019.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Computer Science for Engineers (Ingenieurinformatik)	eII

Person responsible for the module	Faculty
Prof. Dr. Fredrik Borchsenius	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
4	2	mandatory	5

Recommended previous knowledge
Fundamentals of Programming (eGPR)

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Computer Science for Engineers (Ingenieurinformatik)	4 SWS	5

Submodule	Submodule abbreviation
Computer Science for Engineers (Ingenieurinformatik)	**eII**

Responsible person	Faculty
Prof. Dr. Fredrik Borchsenius	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Valter Böhm Prof. Dr. Fredrik Borchsenius Prof. Dr. Marcus Wagner	only in summer semester
Teaching method	
Seminar teaching (SU) Practical course (Pr)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam (90 min)
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Introduction to Matlab and Simulink
- Systems of linear equations
- Regression models
- Introduction to optimisation problems
- Nonlinear systems of equations
- Simulation and analysis of dynamical systems

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- develop Matlab models (2)
- understand Simulink models and to develop simple Simulink models (2)
- write Matlab code to solve linear equations, optimization problems, regression problems, nonlinear equations and dynamic system problems (3)
- choose appropriate numerical methods for certain problems (1)
- analyse and visualize results (2)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • define calculation methods for technical problems (2) • solve computational problems in a team (2)
Teaching materials offered
Lecture script, collection of exercises
Teaching media
Presentation on beamer, exercises on personal computer
Literature
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Design of machine elements 2 (Maschinenelemente 2)	eME2

Person responsible for the module	Faculty
Prof. Dr. Andreas Wagner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
3	2	mandatory	5

Recommended previous knowledge
eME1

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Design of machine elements 2 (Maschinenelemente 2)	4 SWS	5

Submodule	Submodule abbreviation
Design of machine elements 2 (Maschinenelemente 2)	**eME2**

Responsible person	Faculty
Prof. Dr. Andreas Wagner	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Andreas Wagner	only in winter semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam 90 minutes
Approved Aids for Evidence of Achievement
• SHM (Standard tools, page 2) • All handwritten and printed documents supplied by the lecturer (no solved exercises)

Content
• Force-locking shaft-hub connections • Strength verification of dynamically stressed components, multi-stage loading • Technical systems and their mechanical equivalent modelling • Slide bearingsgears and gear drives (spur gear gearboxes)
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • use machine elements software (2) and reliably verify interference fits as shaft-hub connections (3) • design (2) and calculate (2) slide bearings • understand the basics of gear design and transmission ratios (2) • design power gears and involute gearings (2) • calculate (2) and verify (3) cylindrical gear stages
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • independently and confidently perform strength verifications for shafts, hubs and gears (3) • independently design compact, high-load-bearing gear stages (2)

- assess the significance of verification calculations with regard to corporate product liability (2)
- fundamentally understand ethical aspects and social sanctions in the event of damage to life, limb, health and property caused by products (2)

Teaching materials offered
Lecture handout
Teaching media
Computer projector, digital blackboard, calculation sofware
Literature
Roloff/Matek: Maschinenelemente - Lehrbuch und Tabellenbuch, Vieweg Verlag
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Engineering Design 2 (Konstruktion 2)	eKO2

Person responsible for the module	Faculty
Prof. Dr. Florian Nützel	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
3	2	mandatory	5

Mandatory requirements
None
Recommended previous knowledge
eKO1

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Engineering Design 2 (Konstruktion 2)	4 SWS	5

Submodule	Submodule abbreviation
Engineering Design 2 (Konstruktion 2)	**eK02**

Responsible person	Faculty
Prof. Dr. Florian Nützel	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Werner Britten Andreas Eigenstetter (LB) Prof. Dr. Peter Gschwendner Prof. Dr. Stefan Hierl Prof. Dr. Ulf Kurella Prof. Dr. Tobias Laumer Christian Mehltretter (LB) Prof. Dr. Florian Nützel Prof. Dr. Ulrike Phleps Andreas Preischl Prof. Dr. Thomas Schaeffer Prof. Dr. Andreas Wagner	**every second semester
Teaching method	
Exercise	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	30 h

Method of assessment
Practical performance assessment with success
Approved Aids for Evidence of Achievement
None

Content
• Fundamentals of 3D modeling with CAD systems • Capabilities and limitations of 3D CAD systems and models • Creating parametric 2D sketches • Creating manufacturable milling, casting, and welding parts as 3D CAD models • Assembly design - structuring assemblies • Functional, strength-appropriate, and cost-effective solutions for standard design tasks in assemblies • Creating standard-compliant technical drawings of parts and assemblies from 3D CAD models • CAE simulations with CAD systems
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • recognize the importance of CAD systems in the development of technical systems such as machines, vehicles, devices, and plants (2) • understand the responsibility of design and development for adequate communication of part and assembly properties to manufacturing and assembly (2) • communicate between development, calculation, and manufacturing departments within the company using virtual 3D models of mechanical assemblies (2) • discuss the constructive design of parts and assemblies based on technical drawings and identify improvement possibilities (3) • recognize the responsibility of development and design for the functionality, manufacturability, and costs of parts and assemblies (2)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • recognize both the significance of programming and the associated challenges in mechanical engineering (1) • evaluate the advantages and disadvantages of modern computer solutions in mechanical engineering (2) • develop innovative solutions for complex tasks
Teaching materials offered
Exercices
Teaching media
Beamer, CAD-Software

Literature
• Fischer, U. et al: Mechanical and Metal Trades Handbook. Ostfildern: EUROPA Lehrmittel. • Dillinger, J. (ed.): Metal Engineering Textbook. Ostfildern: EUROPA Lehrmittel. • Krulikowski, A.: Fundamentals of Geometric Dimensioning and Tolerancing. Clifton Park, NY: Delmar Cengage Learning. • Simmons, C. H.: Manual of Engineering Drawing. Amsterdam: Elsevier Butterworth Heinemann. • Branoff, Th. J.: Interpreting Engineering Drawings. Stamford, CT: Cengage Learning. • Schmid, S. R. et al: Fundamentals of Machine Elements. Boca Raton: CRC Press. • Budynas, R. G.; Nisbett, J. K.: Shigley´s Mechanical Engineering Design. Singapore: McGrawHill.
More information about the course
Requirements for dual students: • Dual students contact the teaching staff at the beginning of the semester. • In consultation with the dual students, specific topics related to the cooperating company can be incorporated into the module, provided they are relevant to the course content and the students' level of knowledge.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Engineering Design 3 (Konstruktion 3)	eKO3

Person responsible for the module	Faculty
Prof. Dr. Peter Gschwendner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
4	2	mandatory	5

Recommended previous knowledge
eKO1, eKo2, eMe1, eTm1,

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Engineering Design 3 (Konstruktion 3)	4 SWS	5

Submodule	Submodule abbreviation
Engineering Design 3 (Konstruktion 3)	**eK03**

Responsible person	Faculty
Prof. Dr. Peter Gschwendner	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Werner Britten Prof. Dr. Peter Gschwendner Prof. Dr. Stefan Hierl Prof. Dr. Ulf Kurella Prof. Dr. Ulrike Phleps Andreas Preischl Prof. Dr. Thomas Schaeffer Prof. Dr. Carsten Schulz Prof. Dr. Andreas Wagner	**every second semester
Teaching method	
Exercise	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	90 h

Method of assessment
Portfolio examination
Approved Aids for Evidence of Achievement
All

Content

- Computer-aided design (CAD) of a simply structured assembly
- Development of a solution concept
- Representation of a solution idea in the form of a hand sketch
- Design of machine parts, preliminary design, and strength verification
- CAD design and part calculation
- Product documentation: creating bills of materials, assembly, raw, and part drawings, design justifications

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- apply the fundamentals of technical mechanics (2)
- develop solution principles and represent them in the form of hand sketches (3)

- use CAD software (2)
- conduct preliminary designs (3)
- calculate the suitability and safety of common machine elements (3)
- create assembly drawings and manufacturing drawings using CAD (3)
- create calculation documentation (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- develop independent concepts, verify them computationally, and elaborate them using CAD (3)
- independently design common machine elements (3)
- document the development process (3)
- understand the importance of verification calculations in terms of safety/product liability and cost-effectiveness (2)
- understand the ethical aspects and societal sanctions related to damage to life, health, and property caused by products (2)

Teaching materials offered

Assignments, guidelines for writing the term paper, specialized literature, catalogs of semi-finished products and standard parts, standards, software, tutorials, CAD training materials, program manuals, exercises, patents

Teaching media

Overhead projector, blackboard, CAD workstation for each participant, calculation programs, exhibits, computer/projector, internet

Literature

- Roloff/Matek Machine Elements
- Assignments
- Guidelines for writing the term paper
- Catalogs of semi-finished products and standard parts
- Standards
- CAD training materials
- Program manuals
- Exercises
- Patents

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Engineering Mechanics 3 (Technische Mechanik 3)	eTM3

Person responsible for the module	Faculty
Prof. Dr. Fredrik Borchsenius	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
3	2	mandatory	5

Recommended previous knowledge
Engineering Mechanics 1

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Engineering Mechanics 3 (Technische Mechanik 3)	4 SWS	5

Submodule	Submodule abbreviation
Engineering Mechanics 3 (Technische Mechanik 3)	**eTM3**

Responsible person	Faculty
Prof. Dr. Fredrik Borchsenius	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Valter Böhm Prof. Dr. Fredrik Borchsenius Prof. Dr. Ulrich Briem Prof. Dr. Aida Nonn	only in winter semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam 120 min The eTM3 module is examined in the same way in the MB, BE and DEM degree programmes.
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content
• Basic concepts of dynamics • Moments of intertia • Kinematics and dynamics of point masses • Kinematics and dynamics of a rigid body • Relative Kinematics
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • evaluate movements of point masses (2) • calculate moments of inertia, energies and power (3) • asses stable and unstable rotations of rigid bodies (1) • compute the movement of rigid bodies and point masses (3) • calculate relative movements (3) • compute simple planar multi body systems (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • recognize the significant of mechanics in all disciplines of mechanical engineering (1) • cleary describe issues of mechanics (2) • find solution for complicated problems in a team (3) • recognize the importance of mechanics for the sustainability of engineering activities (1)
Teaching materials offered
Lecture script, collection of exercises
Teaching media
Blackboard, presentation on beamer
Literature

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Fluid Mechanics (Strömungsmechanik)	eSM

Person responsible for the module	Faculty
Prof. Dr. Oliver Webel	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
4	2	mandatory	5

Recommended previous knowledge
eMA1, eMA2, eTM1, eTM2

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Fluid Mechanics (Strömungsmechanik)	4 SWS	5

Submodule	Submodule abbreviation
Fluid Mechanics (Strömungsmechanik)	**eSM**

Responsible person	Faculty
Prof. Dr. Oliver Webel	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Sven Wassermann Prof. Dr. Oliver Webel	only in summer semester

Teaching method

- Seminar teaching (SU)
- Tutorials (T)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment

Written exam

Approved Aids for Evidence of Achievement

SHM (Standard tools, page 2), Formula collections currently published in ELO courses (highlighting with text marker permitted)

Content

- Introduction to Fluid Mechanics with applications in Mechanical Engineering
- Physical properties of fluids (viscosity)
- Hydrostatics: pressure, forces on flat and curved surfaces, buoyancy
- Hydrodynamics: pathline, streamline, streakline,continuity equation, Bernoulli equation and applications, momentum equation
- Pipe flow: laminar and turbulent flow, dimensionless quantities, pressure loss
- Borda-Carnot equation

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- differentiation of Newtonian and non-Newtonian fluids (2)
- determination of hydrostatic pressure distributions and resulting forces on walls (3)
- determination of flow velocities, pressure differences with Bernoulli equation and forces on walls with momentum equation (3)
- estimation of pressure losses in pipes (2) and the interpretation of results (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • understanding of relevance of Fluid Mechanics in Mechanical Engineering (2) • participation in discussions with experts (2) • ability to contribute to the subject Fluid Mechanics (2) • understanding of the consequences of Fluid Mechanics in Engineering / Technology (1)
Teaching materials offered
Exercises, formulary
Teaching media
Computer/projector, blackboard, videos
Literature
TBA

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Fundamentals of Electrical Engineering and Electronics (Grundlagen der Elektrotechnik und Elektronik)	eGEE

Person responsible for the module	Faculty
Prof. Dr. Hermann Ketterl	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
3	2	mandatory	5

Recommended previous knowledge
Ma1, Ma2

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Fundamentals of Electrical Engineering and Electronics (Grundlagen der Elektrotechnik und Elektronik)	4 SWS	5

Submodule	Submodule abbreviation
Fundamentals of Electrical Engineering and Electronics (Grundlagen der Elektrotechnik und Elektronik)	**eGEE**

Responsible person	Faculty
Prof. Dr. Hermann Ketterl	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Hermann Ketterl	only in winter semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam 90 minutes
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2) , formulary published on ELO without annotations

Content

- Basic electrical engineering terms, circuit diagrams, laws for the calculation of direct current circuits, direct current networks, direct current systems, direct current measurements
- Electric field: Relationship between field and electric force and voltage, Material dependencies, capacitor, charging and discharging processes
- Magnetic field: field quantities, magnetic flux, ferromagnetism, magnetic circuit, forces in the magnetic field, induction, coil, switching on and off processes
- Alternating current systems: Amplitude, frequency, phase angle, pointer diagrams, active and reactive reactances, impedances, complex alternating current calculation
- Semiconductor materials: physical and electrical properties, conductivity, doping, pn junction
- Semiconductor components: pn-diodes, Z-diode, photodiode, bipolar transistor, Field-effect transistor; characteristic and limit values of components
- Non-linear voltage divider, small and large signal behavior, switching and amplifier applications
- Circuits for voltage and current shaping: DC, AC and mixed voltage, rectification, alternating direction
- Operational amplifiers: characteristics, basic circuits for amplification and signal processing, applications for DC and AC signals

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • analyze direct current networks with several consumers and sources (3) • create equivalent circuit diagrams for real circuits (2) • create and solve linear systems of equations based on node and mesh rules solve (2) • evaluate and use current, voltage and resistance measurements in direct current networks and use them (2) • determine the characteristic parameters of R, L and C components on the basis of their physical structure (2) • to analyze the charging and discharging processes of capacitors and the switching on and off processes of inductances using switched direct current or direct voltage sources based on the solutions of 1st order ordinary differential equations calculate (2) • examine and calculate linear alternating current circuits with the aid of pointer diagrams and complex representation (2) • use the linearization and idealization of circuits with semiconductor components for their applications (2) • calculate the power losses and limiting loads of semiconductor diodes and transistors in switching applications (2) • examine and calculate the voltage and current curve in rectifier circuits calculate (2) • analyze the function of simple operational amplifier circuits in feedback systems systems by setting up mesh equations (3)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • deal with English-language data sheets for electronic components (1) • know and name the basic terms and technical quantities of electrical engineering and electronics in German and English language (1) • give examples of the increasing importance of electronics in the context of interdisciplinary projects (1) • assess the importance of electrical engineering and electronics with regard to the current energy discussion (3)
Teaching materials offered
Books, datasheets
Teaching media
Blackboard
Literature
Felix Hüning, The Fundamentals of Electrical Engineering, De Gruyter

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Industrial Placement (Berufsqualifizierendes Praktikum)	BP

Person responsible for the module	Faculty
Prof. Stefan Galka	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
5	2	mandatory	22

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Industrial Placement (Berufsqualifizierendes Praktikum)		22

Submodule	Submodule abbreviation
Industrial Placement (Berufsqualifizierendes Praktikum)	**BP**

Responsible person	Faculty
Prof. Stefan Galka	mechanical engineering
Lecturer	Availability of module
N.N. N.N.	**every semester

Teaching method
-

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5		german/english	22

Study hours required

Hours in attendance/lectures	Hours for self-study
20 weeks	660 h

Method of assessment
• Practical performance certificate • (Record of activity, 5 written reports, Work Certificate)
Approved Aids for Evidence of Achievement
All

Content
• Introduction to the work of an engineer on the basis of specific tasks in an industrial environment. • The Industrial Placement focuses on engineering work • The findings of previous studies should be subjected to testing and subsequent implementation in practice. • It is imperative that an experienced engineer provides expert guidance in order to fulfill this requirement. • A maximum of three of the following areas may be selected 1. Research and development, project planning, design and construction 2. Production, industrial engineering, production control 3. Planning, operation and maintenance of machines and systems 4. Testing, acceptance and quality inspection 5. Engineering sales
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • apply the theoretical knowledge acquired at the university to practical tasks (2),

- work independently on concrete, simple engineering tasks (2),
- work (2),
- work together with colleagues from different disciplines and departments (2).
- to plan the work to be done and to monitor their own progress (2).
- check their own work progress (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- work on problems in a team (2),
- communicate orally and in writing with colleagues, supervisors, suppliers and customers (2),
- assess their own strengths and weaknesses (2)

Teaching materials offered

Templates in the e-learning platform

Teaching media

None

Literature

None

More information about the course

20 weeks presence in the company (for details, please refer to the examination regulations)

Requirements for dual students:

- Dual students complete the industrial internship at the partner company.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A/B 3	LTA/B 3

Person responsible for the module	Faculty
Christine König (LBA)	

Semester taught according to the curriculum	Level of study	Module type	Credit value
3	2	mandatory	5

Mandatory requirements
LTA1: German at level B1.2 LTB1: Keine
Recommended previous knowledge
None

Content
See Submodule. The module contains a laboratory exercise in materials science and manufacturing methods. For language track A in a seminar unit writing competence in German is taught, for language track B in English.

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A 3 - German as a foreign language (Deutsch als Fremdprache)	6 SWS	5
2.	Language Track B3 -(IHaKo: Analyse kulturell bedingter Konfliktsituationen)	2 SWS	2.5
3.	Language Track B3 - (IHaKo: Wissenschaftliche Grundlagen interkultureller Kompetenz)	2 SWS	2.5

Submodule	Submodule abbreviation
Language Track A 3 – German as a foreign language (Deutsch als Fremdprache)	**LTA 3**

Responsible person	Faculty
Christine König (LBA)	
Lecturer	**Availability of module**
Christine König (LBA)	only in winter semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	6 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
90 h	90 h

Method of assessment
see study plan AW
Approved Aids for Evidence of Achievement
see study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW
Literature
See module handbook AW

More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B3 -(IHaKo: Analyse kulturell bedingter Konfliktsituationen)	**LTB3**

Responsible person	Faculty
Ulrike de Ponte	
Lecturer	**Availability of module**
Ulrike de Ponte	only in winter semester

Teaching method
Seminar teaching

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	2 SWS	german/english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan IRM
Approved Aids for Evidence of Achievement
See study plan IRM

Content
See module handbook IRM
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook IRM
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook IRM
Teaching materials offered
See module handbook IRM
Teaching media
See module handbook IRM
Literature
See module handbook IRM

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B3 - (IHaKo: Wissenschaftliche Grundlagen interkultureller Kompetenz)	**LTB3**

Responsible person	Faculty
Ulrike de Ponte	
Lecturer	**Availability of module**
Ulrike de Ponte	only in winter semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	2 SWS	german/english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan IRM
Approved Aids for Evidence of Achievement
See study plan IRM

Content
See module handbook IRM
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook IRM
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook IRM
Teaching materials offered
See module handbook IRM
Teaching media
See module handbook IRM
Literature
See module handbook IRM

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Language Track A/B4	LTA/B4

Person responsible for the module	Faculty
N.N.	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
4	2	mandatory	5

Mandatory requirements
LTA1: German at level B2.1 LTB1: Keine

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Language Track A 4 (German as a Foreign Language B2.2)	6 SWS	5
2.	Language Track B 4 (IHaKo: Internationale Handlungskompetenz erkennen und fördern)	2 SWS	2.5
3.	Language Track B 4 (IHaKo: Kulturelle Differenz und interkulturelles Handeln)	2 SWS	2.5

Submodule	Submodule abbreviation
Language Track A 4 (German as a Foreign Language B2.2)	**LTA4**

Responsible person	Faculty
	mechanical engineering
Lecturer	**Availability of module**
Christine König (LBA)	only in summer semester
Teaching method	
LT-A/B: Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	6 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
90 h	90 h

Method of assessment
see study plan AW
Approved Aids for Evidence of Achievement
see study plan AW

Content
See module handbook AW
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook AW
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook AW
Teaching materials offered
See module handbook AW
Teaching media
See module handbook AW
Literature
See module handbook AW

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B 4 (IHaKo: Internationale Handlungskompetenz erkennen und fördern)	**LTB4**

Responsible person	Faculty
Ulrike de Ponte	
Lecturer	**Availability of module**
Ulrike de Ponte	only in summer semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	2 SWS	german/english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan IRM
Approved Aids for Evidence of Achievement
See study plan IRM

Content
See module handbook IRM
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook IRM
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook IRM
Teaching materials offered
See module handbook IRM
Teaching media
See module handbook IRM
Literature
See module handbook IRM

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Language Track B 4 (IHaKo: Kulturelle Differenz und interkulturelles Handeln)	**LTB4**

Responsible person	Faculty
Ulrike de Ponte	
Lecturer	**Availability of module**
Ulrike de Ponte	only in summer semester
Teaching method	
Seminar teaching	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	2 SWS	german/english	2.5

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
See study plan IRM
Approved Aids for Evidence of Achievement
See study plan IRM

Content
See module handbook IRM
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, See module handbook IRM
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, See module handbook IRM
Teaching materials offered
See module handbook IRM
Teaching media
See module handbook IRM
Literature
See module handbook IRM

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Mathematics for Engineers 3 (Ingenieurmathematik 3)	eMA3

Person responsible for the module	Faculty
Prof. Dr. Jan-Philipp Weiß	Computer Science and Mathematics

Semester taught according to the curriculum	Level of study	Module type	Credit value
3	2	mandatory	5

Recommended previous knowledge
eMA1, eMA2

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Mathematics for Engineers 3 (Ingenieurmathematik 3)	4 SWS	5

Submodule	Submodule abbreviation
Mathematics for Engineers 3 (Ingenieurmathematik 3)	**eMA3**

Responsible person	Faculty
Prof. Dr. Jan-Philipp Weiß	Computer Science and Mathematics
Lecturer	**Availability of module**
Dr. Doris Augustin Dr. Gabriela Tapken (LBA) Prof. Dr. Stefanie Vogl Prof. Dr. Jan-Philipp Weiß	only in winter semester

Teaching method
Seminar teaching with exercises

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
3	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 Min.

Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), published formulary

Content
The students are aware of and understand the mathematical formalism and have basic knowledge of the mathematical concepts, calculation rules and solution methods within the following areas: • differential calculus in the multi-dimensional case: functions of multiple variables, partial and total differentiation, tangential planes, gradients and directional derivatives, extreme values subject to constraints • integral calculus in the multi-dimensional case: parametrization of curves and surfaces, double and triple integrals on normal domains in 2D and 3D, substitution and transformation rules, applications: center of mass, volumes, rotational bodies, arclength • ordinary differential equations (ODEs): Classification of linear and nonlinear ODEs, solution methods for first order ODEs (separation of variables, variation of constants, substitutions), solution structure for general linear ODEs, solution methods for linear ODEs of arbitrary order with constant coefficients • Fourier series: determination of Fourier series of periodic functions, convergence behavior and properties

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • to identify suitable methods and solution concepts in the fields mentioned above (1) • to apply the studied mathematical methods successfully to the solution of problems and to interpret and to discuss the solutions (2) • to explain the scientific contents dealt with in the lecture (2) • to give mathematical formulations of simple problems and to analyze them (2 and 3) • to read and to understand further mathematical texts in a self-reliant manner (3) • to analyze and to structure complex correlations and to develop solution approaches (3)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • to explain and to communicate the mathematical content in oral and in written form using appropriate technical terms (2) • to work on and to solve mathematical problems in a self-reliant way as well as in work teams (3) • to discuss and to critically dispute their compiled solutions and check for plausibility (2)
Teaching materials offered
Blackboard sketches, lecture slides, exercises
Teaching media
Blackboard, beamer and slides
Literature
• C. Karpfinger, Höhere Mathematik in Rezepten, 3. Auflage, Springer Spektrum, 2017 • L. Papula, Mathematische Formelsammlung, 12. Auflage, Springer Vieweg, 2017 • L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 1, 15. Auflage, Springer Vieweg, 2018 • L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 2, 14. Auflage, Springer Vieweg, 2015 • L. Papula, Mathematik für Ingenieure und Naturwissenschaftler, Band 3, Springer Vieweg • Y. Stry, R. Schwenkert, Mathematik kompakt: für Ingenieure und Informatiker, 4. Auflage, Springer-Verlag Berlin Heidelberg, 2013 • A. Croft, & R. Davison, Mathematics for engineers: a modern interactive approach. Pearson Education, 2009
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Measurement Techniques with Laboratory Exercises (Messtechnik mit Praktikum)	eMT

Person responsible for the module	Faculty
Prof. Dr. Hermann Ketterl	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
4	2	mandatory	5

Recommended previous knowledge
eGEE, eGPR, eMa

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Laboratory Exercise MT (Praktikum Messtechnik)	2 SWS	3
2.	Measurement Techniques (Messtechnik)	2 SWS	2

Submodule	Submodule abbreviation
Laboratory Exercise MT (Praktikum Messtechnik)	**eMTP**

Responsible person	Faculty
Prof. Dr. Hermann Ketterl	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Hermann Ketterl Prof. Torsten Reitmeier	only in summer semester
Teaching method	
Practical course (Pr)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	2 SWS	english	3

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	60 h

Method of assessment
• Lab practical • Attendance • 8 reports with certificate
Approved Aids for Evidence of Achievement
All

Content
Practical application of knowledge from the lecture eMTV in relation to: • signal flow • error influences • application of measurement software • measurement data storage • measurement data evaluation
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • understand how to calibrate and correct systematic errors (2) • analyze and assess the causes of errors (3) • use and suggest different measuring sensors correctly (3) • prepare test reports with diagrams, including fitting functions (2) • apply knowledge of programming, electronics, mechanics and data processing algorithms (3)

- independently familiarize themselves with the operation of devices for digital data acquisition (2)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • use data sheets for electronic measuring systems in English (1) • design metrological tasks in the field of tension between different disciplines and disciplines and trades and to realistically assess their own level of knowledge in relation to the realistically assess their own level of knowledge in relation to the specialist field (2) • recognize opportunities and risks of metrological applications in the course of time with regard to with regard to: the safety relevance of systems and ethical aspects (e.g. protection of personal data) (3)
Teaching materials offered
Descriptions of Experiments, Databooks, Experimental setups,
Teaching media
Experimenal setup, e.g. Breadboard
Literature

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Measurement Techniques (Messtechnik)	**eMTV**

Responsible person	Faculty
Prof. Dr. Hermann Ketterl	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Hermann Ketterl	only in summer semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	2 SWS	english	2

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	30 h

Method of assessment
Written exam 90 Min
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Purpose of measurement
- Basic systems, basic units
- Static measurement error, systematic and random measurement error
- Measurement uncertainty
- Dynamic measurement error
- Digital measurement data acquisition
- Active and passive transducers

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- know the meaning of metrological terms (1)
- understand the laws of calibration and correction of systematic errors and apply them (2)
- follow calculation procedures for calculating the measurement uncertainty (2)
- apply the method of the minimum of the error squares (2)
- develop digital measurement data acquisition according to time and value axis (3)
- examine digital measurement data in the time domain and frequency domain (2)
- state the function of the most important active and passive sensors (1)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • use data sheets for electronic measuring systems in English. (1) • design metrological tasks in the field of tension between different disciplines and disciplines and trades • realistically assess their own level of knowledge.(2) • recognize opportunities and risks of metrological applications in the course of time with regard to with regard to: safety relevance of systems and ethical aspects (e.g. protection of personal data). (3)
Teaching materials offered
Lecture handout
Teaching media
Blackboard
Literature

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Project Management and Quality Assurance (Projektmanagement und Qualitätssicherung)	PQS

Person responsible for the module	Faculty
Prof. Dr. Claudia Hirschmann	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
5	2	mandatory	4

Mandatory requirements
Note for IME: The PQS module is one of the practical courses and can therefore only be taken if the admission requirements for the practical semester are met. The PQS module is one of the modules in the second stage of the program and can therefore only be taken if the admission requirements have been met.
Recommended previous knowledge
german

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Project Management and Quality Assurance (Projektmanagement und Qualitätssicherung)	4 SWS	4

Submodule	Submodule abbreviation
Project Management and Quality Assurance (Projektmanagement und Qualitätssicherung)	**PQS**

Responsible person	Faculty
Prof. Dr. Claudia Hirschmann	mechanical engineering
Lecturer	**Availability of module**
Wolfgang Dötter (LB) Prof. Dr. Claudia Hirschmann Prof. Dr. Christian Rechenauer	**every semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5	4 SWS	german	4

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	60 h

Method of assessment
Written exam, 60 Min.
Approved Aids for Evidence of Achievement
None except pocket calculator

Content

- International importance of the topics of quality (Q), Q management/Q assurance, term and, possibly: dimensions of "quality"; continuous improvement (PDCA), "Rule of Ten", Q awards and EMAS
- Quality management (QM): QM in the product life cycle and product development process, quality policy, quality management systems (QMS), ISO 9000ff series of standards, ISO 9001, integrated management systems according to current standards, EMAS and sustainability report,
- Total Quality Management (TQM), EFQM, possibly: industry-specific standards like e.g., containing reference to ISO 13485
- Quality methods and tools: Ishikawa diagram and 4M/8M,
- Fault Tree Analysis (FTA), Failure Mode and Effects Analysis (FMEA),
- Kano model, Quality Function Deployment (QFD) with HoQ including the 4 HoQ & management of sustainability requirements, benchmarking,
- 8D report, Poka Yoke, 5s method, Five- Whys- method,
- Process flowchart, process profile, possibly the "seven tools of quality",
- Possibly: decision trees, possibly: additional hazard analyses,
- Quality assurance methods, audits, certifications
- Quality controlling, cost of quality
- Quality and law: Machinery Directive and Machinery Regulation, product safety, product liability, CE marking, GS mark
- Product and production risk management, safety Integrity level (SIL), PL (performance level), possibly: protective devices
- CAQ Computer Aided Quality Assurance, digitalization and its impact, opportunities, and challenges regarding topics in Q management and Q assurance,
- Process management, process control, also consideration of safety and security,
- Quality control charts (QRK)
- Possibly: introduction to statistical process control (SPC) with types of variables, sampling,
- Possibly: measurement system analysis (MSA), process capability analysis (PFU), test laboratories
- Basics of project management: project definition, project phases, magic triangle/ 'devil's square', influencing factors, project charter, possibly: project profile;
- Aims of the project, SMART rule, possibly: SWOT analysis;
- DIN 69901, possibly: PMBOK Guide;
- Examples of large projects, etc.
- Project organizational structures, project management, project team, communication, information management, and possibly: e.g., communication models, analysis of project environment, stakeholder analysis, roles analysis and responsibilities
- Various methods of project management:
- Project planning, planning methods: work breakdown structure, network analysis including calculations,
- Schedule plans and cost plans, activity lists, Gantt charts, and, e.g., cost estimating, quality gates, etc.
- Project schedule management, project cost management
- Project risk management, possibly: change management; possibly: problem-solving methods,
- Current trends in project management: possibly: e.g., agile methods like, e.g., SCRUM
- Project controlling and project documentation, milestone trend analysis (MTA),
- Possibly: additional project key figures; possibly: performance indices,
- Possibly: case study with MS Project

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- state characteristics of quality (1) and name and plan improvements opportunities in quality management and quality management systems (QMS) (2)
- develop and compile room for improvement regarding the quality of products, processes, and projects (2)
- name the fundamentals of quality management and quality assurance (1)
- compile selected aspects of ISO 9000, ISO 9001, TQM and EFQM and integrated management systems (2) and assess and analyze a QMS regarding ISO 9001, TQM and EFQM (2)
- realize and assess the importance and value of EMAS and sustainability (2), realize and assess the relationship between Q and EMAS (3)
- create, analyze, and interpret diagrams and documentation of the quality methods and tools: Ishikawa diagram and 4M/8 M method, and Five- Whys- method, FTA, FMEA, QFD and HoQ, 8D report, Kano model, benchmarking, Poka Yoke, 5s method, process flowchart, process profile (3)
- demonstrate and apply analyses on presentations of sustainability issues using Q methods (2)
- possibly: execute the seven tools of quality (2)
- handle checklists, work instruction, procedure instructions, conduct audits, reviews, prepare audit-relevant scenarios (2)
- prepare and compile procedures regarding Q-controlling and Q-costs (2)
- state the importance of impact analyses regarding product safety and product liability, as well as in product and production risk management (1),
- to describe and explain the importance of SIL and PL (in risk management) (3),
- compile and evaluate the relationship between Q and law, CE, and GS markings (3), and possibly: assess protective devices regarding SIL (3)
- name (1) and assess (2) the importance of CAQ, digitalization and their impact on selected Q topics, on process management and on process control,
- possibly: compile types of variables (2)
- create and interpret QRK (3),
- possibly: calculate, assess, and interpret the associated indicators (3)
- possibly: describe PFU with the common indicators (3) and possibly: describe MSA (3)
- state the basics of project management (1)
- state and use: project definition, project phases, magic triangle/ 'devil's square', influencing factors, project charter, aims of the project, & possibly: project profile (2)
- describe and use SMART rule (3),
- compile selected aspects regarding DIN 69901 and examples of large projects, and possibly: compile SWOT analysis and selected aspects regarding PMBOK Guide (2)
- describe project organizational structures and related aspects, communication, information management and, possibly: e.g., communication models, describe environment analysis, stakeholder analysis, role analysis and responsibilities (3)
- assess and evaluate suitable and existing project organizational structures (3); and plan, develop and compile e.g., project management tasks and tasks of the project team (3)
- create, analyze, interpret, and evaluate diagrams, documentation, and calculations regarding planning methods, such as work breakdown structures, network analysis including calculations, schedule plans and cost plans, activity lists, Gantt charts, quality gates, and possibly additional cost estimating (3)
- apply the SMART rule (2), and possibly: prepare and evaluate a SWOT analysis (3)
- develop, elaborate, and explain project schedule management, project cost management and project risk management (3)

- plan, set up and explain project controlling and project documentation (3), prepare and interpret MTA (3), and possibly: calculate and interpret performance indices and additional project key figures (3)
- name project planning software (1)
- elaborate and interpret the above-mentioned project methods using a case study (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- assess and recommend product and production safety management and corresponding risk management as an ethical responsibility (3) and handle and implement them with ethical responsibility (2)
- handle original material in English, e.g., on EFQM and TQM (2) and state the international, interdisciplinary importance of PQS topics (1)
- assess and develop their own responsibility for safe and regulatory compliant products and processes of good quality (3)
- state, assess and evaluate interdisciplinary effects of their actions and technology assessment regarding quality and e.g., liability and in projects (3)
- assess, evaluate, and appreciate the fundamental ideas of TQM and its overarching effects (3)
- develop, elaborate, and demonstrate appropriate PQS-based positions in planning and decision-making processes (3)
- develop, propose, and evaluate useful and objectively justified proposals with respect to “PQS” for products, product developments, production processes and projects (3)
- perform and reflect on teamwork, e.g., in risk analyses (e.g., FMEA), in an FTA, in problem-cause analyses (e.g., Ishikawa diagram) or in 8D reports (3)
- carry out and reflect on teamwork in projects (3)
- possibly: state and use the 'four-eyes principle' (2)
- transfer, use and develop project management methods, e.g., from communication, planning, etc. even into other areas (3)
- reflect on, assess, and evaluate the role and importance of quality assurance in a wide range of areas, including project management (3)
- characterize quality assurance and project management in different industries and assess their respective importance (3)
- carry out, compile, assess and reflect on management tasks in project management or quality management (3)
- state, assess and develop their own responsibility for good product and production quality as well as for a good project result (3)
- state, assess and develop their own responsibility for the sustainability of products and in production, e.g., regarding quality and project management issues (3)state, assess and develop own responsibility for handling responsibly data, digitalization, and CAQ (3)

Teaching materials offered

Lecture handout, course in E-Learning platform

Teaching media

Computer/projector, blackboard, videos, presentations, overhead projector

Literature
• DIN EN ISO 9000, Quality management systems - Fundamentals and vocabulary. • DIN EN ISO 9001, Quality management systems – Requirements. • Project Management Institute: A Guide to the Project Management Body of Knowledge (PMBOK® Guide) • Benes/Groh: Grundlagen des Qualitätsmanagements, Hanser. • Brüggemann/Bremer: Grundlagen Qualitätsmanagement: Von den Werkzeugen über Methoden zum TQM, Springer. • DIN 69901-2, Projektmanagement – Projektmanagementsysteme– Teil 2: Prozesse, Prozessmodell. • Fiedler: Controlling von Projekten, Springer. • Jakoby: Projektmanagement für Ingenieure, Springer Vieweg. • Kairies: Professionelles Produktmanagement für die Investitionsgüterindustrie, expert., • Kraus/Westermann: Projektmanagement mit System Springer. • Linß: Qualitätsmanagement für Ingenieure, Hanser. • Litke: Projektmanagement: Handbuch für die Praxis, Hanser • Olfert/Steinbuch: Kompakt-Training Projektmanagement, Kiehl • Schelle/Linssen: Projekte zum Erfolg führen, dtv. • Schwanfelder: Internationale Anlagengeschäfte, Gabler. • Sommerhoff/Kamiske: EFQM zur Organisationsentwicklung, Hanser • Suzaki: Modernes Management im Produktionsbetrieb. Hanser.Theden/Colsman: Qualitätstechniken: Werkzeuge zur Problemlösung und ständigen Verbesserung, Hanser. • Wolf: Projektarbeit bei kleinen und mittleren Vorhaben. Expert. • Zollondz: Grundlagen Qualitätsmanagement. De Gruyter

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Sustainability, Life Cycle Assessment, Business Administration (Nachhaltigkeit, Ökobilanz und Betriebswirtschaft)	NÖB

Person responsible for the module	Faculty
Prof. Dr. Claudia Hirschmann Prof. Dr. Ulrike Phleps	mechanical engineering mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
5	2	mandatory	4

Mandatory requirements
Note for IME: The NÖB module is one of the practical courses and can therefore only be taken if the admission requirements for the practical semester are met. The NÖB module is one of the modules in the second stage of the program and can therefore only be taken if the admission requirements have been met.
Recommended previous knowledge
german

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Sustainability, Life Cycle Assessment, Business Administration (Nachhaltigkeit, Ökobilanz und Betriebswirtschaft)	4 SWS	4

Submodule	Submodule abbreviation
Sustainability, Life Cycle Assessment, Business Administration (Nachhaltigkeit, Ökobilanz und Betriebswirtschaft)	**NÖB**

Responsible person	Faculty
Prof. Dr. Claudia Hirschmann Prof. Dr. Ulrike Phleps	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Claudia Hirschmann Brigitte Kauer (LB) Prof. Dr. Ulrike Phleps	**every semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
5	4 SWS	german	4

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	60 h

Method of assessment
Portfolio exam
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content
Fundamentals of the concept and facets of business administration: • Selected thinking techniques, reasoning techniques and methods of business administration: • Subject matter of business administration and its importance on an engineer, • Economy and economic concept, economic principles • Companies and enterprise, types of business, legal forms of enterprises, objectives of the companies, • Overview of the organizational structure of a manufacturing company, organizational forms, job organization in a manufacturing company, • Location decisions, location factors, multi criteria decision analysis (MCDA): scoring model for benefit analysis, • Business functions from corporate management to accounting, • Value chain, and possibly: business models • Management tasks, management styles, employee management • Production theory, factors of production, useful life, capacity • Operating resources and capacity, materials and ordering, materials managementProduction, production structures, production types, organizational types of production, and possibly: batch sizes • Operational goods and services (production) in procurement, warehousing, • ABC analysis, and possibly: XYZ analysis, • Innovation management a. Possibly: Supplier management and make or buy decisions, b. Possibly: labour and wage payment methods and co-determination, c. Key figures, such as, e.g., asset intensity, productivity, profitability, profit, return on investment (ROI) with reference to effectiveness and efficiency, d. Possibly: economies of scale and degression effect e. Possibly: basic concepts of marketing relating to NÖB topics, Industry 4.0, cyber-physical systems relating to NÖB topics, Fundamentals of the concept and facets of sustainability and life cycle assessment: • Sustainability, accounting, • Evaluation methods of economy & ecology: parameter money <=> CO2eq / methods including structure, approach, quality • Feedback / LCC / LCA (CO2eq, pollutants, water, ...)
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • state the fundamentals of the concept and facets of business administration (1) • use the selected thinking techniques, reasoning techniques and methods of business administration, (2) • compile (1), evaluate (3) and discuss (3) selected subject matters and basic facts of business administration and of a company, economic fundamentals, economic principles, objectives of the companies, business functions, value chain and possibly: business models,

- analyse and assess a company and enterprise, types of business, legal forms of enterprises, objectives of the companies, production theory, production factors, useful life, capacity (3),
- specify, select, and evaluate management tasks, management styles, employee management (1, 2, 3),
- specify, select, and evaluate production types, organizational types of production, organizational structure of the industrial company, organizational forms, job organization in an industrial company (3),
- snalyse operating resources and capacity, materials and ordering (3),
- carry out, analyse, and assess site selection and multi criteria decision analysis (MCDA) using the scoring model for benefit analysis (2, 3),
- compile, analyse, and assess the operational service provision, value-added process and value chain, production factors (operating resources, materials, labour, ...), materials management, production structures (1, 2, 3),
- analyse procurement and warehousing, material ordering, and possibly: batch sizes (3)

a. prepare, elaborate, interpret, and evaluate ABC analysis, and possibly: XYZ analysis (2, 3),
b. possibly: investigate labour, wage payment methods, co-determination (2),
c. calculate and rate typical key figures, like e.g., asset intensity, productivity, profitability, profit, return on investment (ROI) with reference to effectiveness and efficiency (3),
d. possibly: differentiate, analyse, and evaluate productivity and profitability and their relationship to effectiveness and efficiency (3),
e. possibly: analyse and evaluate economies of scale and the degression effect (3),

- explain and present innovation management (3),
- possibly: explain, present and assess functions, principles and legalities and dependencies regarding make-or-buy, supplier management and marketing in a fundamental way (3),
- name the connection between Industry 4.0, cyber-physical systems (CPS) and business administration topics (1),
- assess the climate impact of their professional activities, using open-source databases and software (2,3),
- the students tested this out on a specific project task (1,2,3),
- knowledge and initial experience of cost types and cost estimation methods (1,2).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- state the interdisciplinary importance of NÖB topics (1)
- state the interdisciplinary effects of their actions even in the presence of information asymmetries (1) and critically analyse and reflect on operational situations from an NÖB perspective (3),
- compile, introduce and present appropriate positions from an NÖB perspective in planning and decision-making processes in a target group-oriented manner (3),
- take responsibility in groups or organizations for NÖB topics and reflect on and analyse them from both ethical and modern digitalization perspectives (3),
- develop, justify, and present decisions and actions alternatives from an NÖB perspective (3)
- analyse and reflect on the ethical implications of decisions in a business administration context and NÖB context (3),
- elaborate application-oriented and research-oriented questions from the NÖB environment in a scientifically sound and largely self-directed manner (2,3),

- use selected thinking techniques and argumentation techniques from business administration or the NÖB environment in new situations, as well, and apply them in a methodical approach and independent work (2),
- independently recognize and handle dilemma situations in the context of business administration and NÖB (2),
- state impacts, opportunities, and challenges of digitization in the business administration context and NÖB context (1),
- assess the climate impacts of their professional activities, using open-source databases and software (2,3),
- the students tested this out on a specific project task (1,2,3).

Teaching materials offered

Lecture handout, course on E-Learning platform

Teaching media

Computer/projector, blackboard

Literature

- Jung: Allgemeine Betriebswirtschaftslehre, De Gruyter Oldenbourg.
- Sturm: Allgemeine Betriebswirtschaftslehre, Oldenbourg.
- Thommen/Achleitner/Gilbert/Hachmeister/Kaiser/Jarchow: Allgemeine Betriebswirtschaftslehre, SpringerGablerWöhe/Döring/Brösel: Einführung in die Allgemeine Betriebswirtschaftslehre, Vahlen.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Thermodynamics 2 (Thermodynamik 2)	eTD2

Person responsible for the module	Faculty
Prof. Dr. Thomas Lex	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
4	2	mandatory	5

Recommended previous knowledge
Thermodynamics 1

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Thermodynamics 2 (Thermodynamik 2)	4 SWS	5

Submodule	Submodule abbreviation
Thermodynamics 2 (Thermodynamik 2)	**eTD2**

Responsible person	Faculty
Prof. Dr. Thomas Lex	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Belal Dawoud Prof. Dr. Johannes Eckstein Prof. Dr. Thomas Lex	only in summer semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
4	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
45 h	115 h

Method of assessment
Written exam
Approved Aids for Evidence of Achievement
• SHM (Standard tools, page 2) • Formulary collections published in the ELO courses, including handwritten annotations, as well as the tabular works published there.

Content
• Gas-vapor mixtures using the example of humid air • Fundamentals of combustion calculation • Fundamentals of heat transfer • Differential equation of heat conduction with boundary conditions • Stationary, one-dimensional heat conduction • Unsteady heat transport (semi-infinite body, lumped capictance method) • Convective heat transfer • Heat exchangers (types/flow scheme/balancing/design) • Thermal radiation (basics, simple radiation exchange relationships) • Heat transfer during phase transition (evaporation, condensation) • Enlarged surfaces
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • to calculate the thermal and caloric properties of humid air (2) and assess the basic operations of air conditioning (3)

- to know (1) and calculate (2) the air conditioning processes that are relevant in practice.
- to set up the reaction equations of gaseous, liquid and solid fuels (1) and to calculate the mass and mass fractions in the dry and wet state (2).
- to differentiate the respective heat transport phenomena (1) and
- to analyse heat transport problems accordingly (3).
- to balance the heat and enthalpy flows (2) and to analyse temperature curves (stationary/ transient) (2) and evaluate them (3), as well as other relevant transport variables (thermal resistances, heat transfer coefficients, radiation parameters) (2) and apply them appropriately (3).
- to design heat exchangers (2) and evaluate their functionality (3).
- to apply the 0D and 1D differential equations and boundary conditions for the steady-state and transient temperature profile in solids (1).
- to deal with temperature and pressure-dependent material value tables (2) and evaluate the implicit information on the material system (3).
- to compile the basic velocity and temperature profiles for forced and free convection (2).
- to name the basic phenomena of evaporation and condensation (1) and determine the resulting heat transfer (2).
- to calculate the influence of increased surface area on heat transfer (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- to communicate with experts and non-specialists in a subject-specific manner (2) and contribute constructively and sustainably to social energy discussions (2).
- to work on thermos technical issues in a structured and goal-oriented manner (2).
- to independently deepen further subject-specific knowledge (3).
- to analyse the fundamental role of heat transfer in the energy transition (3).
- to analyse the cross-industry fields of application (automotive, building technology,electrical engineering, energy and process technology, refrigeration and air conditioning technology) of heat transfer (3).
- to be more aware of energy use and energy conversion with regard to the environment (3)

Teaching materials offered

Script, working documents (collection of formulas), collection of exercises, additional diagrams and tables, computer programs

Teaching media

z.B. computer/projector, blackboard

Literature

- Cerbe, G. & Wilhelms, G.; Technische Thermodynamik, Theoretische Grundlagen und praktische Anwendungen, 17. Auflage, Carl Hanser Verlag München, 2013.
- Yunus Cengel und Michael A. Boles, Thermodynamics; an Engineering Approach, 4th Edition,McGraw-Hill Higher Education, 2002.
- Incropera/Dewitt: Foundations of Heat Transfer, 6th Edition, Wiley
- Baehr/Stephan: Wärme- und Stoffübertragung, 2010, Springer Verlag
- Polifke/Kopitz: Wärmeübertragung − Grundlagen, analytische und numerische Methoden, Pearson Studium, 2009
- VDI Wärmeatlas:2019, Springer Verlag

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title		Module code
Advanced Heat and Power Cycles (Höhere Wärme- und Kraftprozesse)		eHPC
Person responsible for the module	Faculty	
Prof. Dr. Andreas Lesser	mechanical engineering	

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Advanced Heat and Power Cycles (Höhere Wärme- und Kraftprozesse)	4 SWS	5

Submodule	Submodule abbreviation
Advanced Heat and Power Cycles (Höhere Wärme- und Kraftprozesse)	**eHPC**

Responsible person	Faculty
Prof. Dr. Andreas Lesser	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Andreas Lesser	**every second semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

Demand for heat and power in Germany and the EU
General possibilities for the supply of power and heat and the challenges in terms of supply security, resource and environmental protection, and social justice.
Supply of power and heat using thermodynamic cycles.
Cycles for heat (heat pumps)

- Structure of the basic process, components, performance classes
- Selection and significance of the working medium
- Importance of heat transfer (latent, sensible, pinch point)
- Subcritical, transcritical, and supercritical processes
- Significance of compression (intercooling, rise of the dew line)
- Influence of the heat source ("infinitely large" e.g., air and "finite" e.g., geothermal, residual heat)
- Optimization possibilities

Cycles for the supply of power

- Importance of the temperature of the heat source, typical temperature levels in sustainable heat sources
- Cycles for utilizing heat sources with low temperature levels (e.g., ORC and Kalina cycles)
- Influence of the working medium
- Influence of the components
- Influence of the heat source

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- to know the demand for work and heat in Germany and the EU. (1)
- to identify the possibilities for meeting this demand. (1)
- to estimate the consequences of the provision methods in terms of supply security, resource and environmental protection, and social justice. (2)
- to name (1), understand (2), and assess (3) thermodynamic cycles that can provide heat and/or work.
- to know and understand the challenges of the respective processes. (2)
- to be able to select and fundamentally design suitable processes for the respective application. (3)
- to understand and analyze the use and influences of cycle process components and working media. (3)
- to be able to assess and evaluate the influences of the given boundary conditions, such as the type of heat source or sink. (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- to cooperatively develop knowledge. (2)
- to address complex practical problems of future energy supply. (2)
- to convey relevant basic concepts and key figures in English. (2)

- confident handling of technical language and communication on the above-mentioned topics. (1)
- understanding and interpreting advanced correlations. (3)
- to justify one's professional actions with theoretical and methodological knowledge and to reflect on alternative designs. (3)
- to capture, address, and solve engineering tasks in the field of advanced energy systems. (2)

Teaching materials offered
Lecture handout
Teaching media
Computer/projector, blackboard
Literature
tbd
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Air Conditioning and Refrigeration (Klima und Kältetechnik)	KKT

Person responsible for the module	Faculty
Prof. Dr. Christian Rechenauer	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Recommended previous knowledge
• Thermodynamics 1 • Thermodynamics 2 • Fluid Mechanics

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Air Conditioning and Refrigeration (Klima und Kältetechnik)	4 SWS	5

Submodule	Submodule abbreviation
Air Conditioning and Refrigeration (Klima und Kältetechnik)	**KKT**

Responsible person	Faculty
Prof. Dr. Christian Rechenauer	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Thomas Lex Prof. Dr. Christian Rechenauer	**every year

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written Exam, 90 min.
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2). 1 DIN-A4 page(hand-written, front and back side)

Content

- Meteorological principles
- Thermal comfort
- Design and operation of air conditioning systems
- Heat exchangers incl. hydraulic circuits
- Heat recovery, humidifiers, fans, duct network
- Function and behaviour of various air diffusers
- Design of air conditioning systems in the h,x diagram
- Control of air conditioning and refrigeration systems
- Design and components of compression chillers
- Calculation and design of refrigeration systems in the lg p, h diagram
- Refrigeration processes, functioning of absorption refrigeration systems

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- to design air conditioning systems (2) and analyse and evaluate them (3)
- to visualise and calculate the state changes in the h,x diagram (2)
- to calculate the individual components of an air conditioning system (2)
- to estimate indoor air flows (3)
- to work out thermal comfort with an air conditioning system (2)

- to design (2) and analyse (3) a refrigeration syste
- to visualise and calculate the cooling process in the lg p,h diagram (2)
- to assess the function of the individual components and calculate them (2)
- to assess refrigeration processes (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • to realistically assess their own level of knowledge in relation to the specialist area (3) • to ssess the ecological and economic effects of air conditioning and refrigeration systems (3) • to exchange ideas with specialised partners on an interdisciplinary basis (1)
Teaching materials offered
Scripts, e-learning platform, exercises, video
Teaching media
z.B. computer/projector, blackboard, software, videos
Literature

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Applied Aerodynamics (Angewandte Aerodynamik)	AAD

Person responsible for the module	Faculty
Prof. Dr. Sven Wassermann	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. od. 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Applied Aerodynamics (Angewandte Aerodynamik)	4 SWS	5

Submodule	Submodule abbreviation
Applied Aerodynamics (Angewandte Aerodynamik)	**AAD**

Responsible person	Faculty
Prof. Dr. Sven Wassermann	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Sven Wassermann	**every second semester

Teaching method

- Seminar teaching (SU)
- Tutorials (T): wind tunnel experiment(s), computational exercises

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. od. 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment

Written exam

Approved Aids for Evidence of Achievement

SHM (Standard tools, page 2), 1 A4 page (front- and backside) handwritten

Content

- Detailed description of aerodynamic flow phenomena (examples from practice)
- Geometric and aerodynamic characteristics of typical reference bodies (e.g. typical blunt bodies focused on automotive industry)
- Difference between pressure and frictional resistance and their effects
- Laminar and turbulent boundary layers
- Techniques for influencing the flow (e.g. boundary layer control)
- Introduction to wind tunnel testing
- Measurement probes and techniques for determining forces, pressure, and velocity
- Experiment(s) in the laboratory wind tunnel/flow measurement technology
- Introduction to numerical fluid mechanics
- Computational fluid dynamic (CFD) exercises for simple aerodynamic applications

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- explain and characterize typical flow phenomena and techniques for influencing the flow (2)
- analyse the formation mechanism of aerodynamic forces (2)
- derive dimensionless force quantities from measurements or CFD simulations (3)
- plan and/or evaluate basic wind tunnel experiments and CFD simulations (3)

- estimate results with regard to plausibility and order of magnitude (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • understand the relevance of the subject in engineering projects (2), • participate in technical discussions with experts (2), • develop possible solutions with the help of dimensional analysis, experiments, or numerical simulations (1), • set up and/or evaluate simple wind tunnel measurements (3), • set up and/or evaluate simple CFD simulations (3), • understand the impact of advanced fluid mechanics on humans and the environment (1)
Teaching materials offered
Lecture handout, collection of exercises
Teaching media
Personal computers, projector, videos, wind tunnel
Literature
TBA

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Bachelors Thesis (Bachelorarbeit)	BA

Person responsible for the module	Faculty
Vorsitzende.r der Prüfungskommission B-MB	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
7	3	mandatory	12

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Bachelors Thesis (Bachelorarbeit)		12

Submodule	Submodule abbreviation
Bachelors Thesis (Bachelorarbeit)	**BA**

Responsible person	Faculty
Vorsitzende.r der Prüfungskommission B-MB	mechanical engineering
Lecturer	**Availability of module**
Vorsitzende.r der Prüfungskommission B-MB	**every semester
Teaching method	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7		german/english	12

Study hours required

Hours in attendance/lectures	Hours for self-study
0 h	360 h

Method of assessment
Bachelor Thesis including presentation
Approved Aids for Evidence of Achievement
all

Content

- independent engineering work on a comprehensive topic
- preparation of results in scientific form
- documentation of results in scientific form

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- work independently on a major engineering topic (3),
- prepare results in a scientific form (3),
- document results in scientific form (3).

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- understand complex tasks and deal with them in depth (3),
- plan the steps necessary to solve complex tasks, divide them into work packages, and work on them in a structured manner (2),
- conduct scientific and technical literature research (2),
- Compare alternative solutions and weigh them up in a reasoned manner (3)

- Distinguish your own results from the state of the art and realistically assess your own level of knowledge in relation to the subject area (2)
- Present technical facts in an appropriate, concise, and accurate manner and reproduce them in correct technical language (2).

Literature

More information about the course

Requirements for dual students:

- Dual students write a bachelor's thesis in collaboration with their partner company.
- The bachelor's thesis, worth 12 credits, is completed as an external thesis at the partner company.
- The partner company suggests a suitable topic and coordinates this with the supervisor at OTH Regensburg.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Computer Aided Engineering (Computergestütztes Ingenieurwesen)	CAE

Person responsible for the module	Faculty
Prof. Dr. Ulf Kurella	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6 or 7	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Computer Aided Engineering (Computergestütztes Ingenieurwesen)	4 SWS	5

Submodule	Submodule abbreviation
Computer Aided Engineering (Computergestütztes Ingenieurwesen)	**CAE**

Responsible person	Faculty
Prof. Dr. Ulf Kurella	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Ulf Kurella	**every second semester

Teaching method
Seminar teaching (SU) (2SWS) and Practical course (Pr) (2SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6 or 7	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 min

Approved Aids for Evidence of Achievement
SHM (Standard tools, see page 2)

Content

- History of Computers, History of CAD-Systems, Machines as subsystems
- Units
- Methodical Foundations
- Family tables (Parts, Parameters as tables)
- Pro/Programm (Design and passing-on of data)
- FEM (drilled hole, one Part, quasi-static, “infinite” stretch limit)
- Optimization (relief notch, one Part, quasi-static, “infinite” stretch limit)
- Simulation (one Part, with gravitation, without friction)
- Generative Design
- Injection molding
- Flow Analysis

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- to name the methodical foundations (1)
- to understand the differences between zones of the same design, parts and the and comprehensive design (3)

- passing-on of data when designing comprehensively (2) and
- the need to comprehend the linking (3)
- to order the partial systems FEM, Optimization and Simulation by their parameters (2)
- to order the partial systems Generative Design, Injection molding and Flow Analysis by thein parameters (2)
- and to understand the limits of the representation (1)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
- to know the prerequisites for a job displacement (1)

Teaching materials offered

Skript based on:
- Brökel, Klaus
- Pro/ENGINEER
- Pearson Studium, München 2008
- Kloninger, Paul
- Pro/MECHANICA verstehen lernen
- Springer, Berlin 2009
- Schumacher, Axel
- Optimierung mechanischer Strukturen
- Springer, Berlin 2005
- Vajna, Sandor; Christian Weber; Helmut Bley; Klaus Zeman
- CAx für Ingenieure
- Springer, Berlin 2009
- Vogel, Manfred; Thomas Ebel
- Pro/Engineer und Pro/Mechanica
- 4., vollständig neu bearbeitete Auflage
- Hanser, München 2006

Teaching media

Computer/projector, blackboard, PC for every participant

Literature

See Teaching materials

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Control Engineering with Laboratory Exercises (Regelungstechnik mit Praktikum)	eRT

Person responsible for the module	Faculty
Prof. Torsten Reitmeier	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6	3	mandatory	5

Recommended previous knowledge
eMA1/eMA2, eGEE und eMTV

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Control Engineering (Regelungstechnik)	3 SWS	4
2.	Laboratory Exercises: Control Engineering (Regelungstechnik mit Praktikum)	1 SWS	1

Submodule	Submodule abbreviation
Control Engineering (Regelungstechnik)	**eRTV**

Responsible person	Faculty
Prof. Torsten Reitmeier	mechanical engineering
Lecturer	Availability of module
Prof. Torsten Reitmeier	**every semester

Teaching method
Lecture course (Vo), 2 SWS Exercise, 1 SWS

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6	3 SWS	english	4

Study hours required

Hours in attendance/lectures	Hours for self-study
45	75

Method of assessment
Written exam (90 min)
Approved Aids for Evidence of Achievement
SHM (Standard tolls, page 2) without your own writing paper, 1 printed and/or written DIN A4 sheet

Content
Basic concepts of control engineering: • description of linear systems in the time and frequency domain • properties of important transfer elements in the time and frequency domain • control devices • analysis of the behavior of linear control loops • stability of linear dynamic systems • selected methods for the design and application of control systems
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • explain the structure and mode of operation of control loops (1) • understand dynamic processes in both the time and frequency domain (3) • describe (2), analyse (3) and synthesize (3) linear, time-invariant systems in the time and frequency domain using various methods • apply the Laplace transform (2) • apply different methods for stability testing (2) • distinguish between different control devices (1) • understand control engineering problems (3) and solve them independently (3)

- design single-loop control circuits (3)
- proceed methodically when solving control engineering problems (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • work out technical issues by themselves using scientific texts (2) • discuss technical issues in exercises and online forums (2) • solve control engineering exercises together in a team (2) • work on self-organized blended learning units (2) • understand the role and importance of control engineering in different applications and fields of application (2) • critically evaluate the results of calculations (3)
Teaching materials offered
Script, exercises, course e-learning platform
Teaching media
Computer/projector, blackboard
Literature
See literature list in the eRTV script

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Submodule	Submodule abbreviation
Laboratory Exercises: Control Engineering (Regelungstechnik mit Praktikum)	**eRTP**

Responsible person	Faculty
Prof. Torsten Reitmeier	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Hermann Ketterl Hans-Peter Landgraf (LB) Johannes Milaev (LB) Prof. Torsten Reitmeier Prof. Dr. Thomas Schlegl	**every semester
Teaching method	
Practical course (Pr)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6	1 SWS	english	1

Study hours required

Hours in attendance/lectures	Hours for self-study
15 h	15 h

Method of assessment

- Practical performance test
- Attendance, 5 papers with certificate

Approved Aids for Evidence of Achievement

All

Content

Experimental investigation of real control systems:

- simulation of control loops
- operation of control devices
- system and parameter identification, distance control
- speed control loop, level control, temperature control, pressure control

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- apply theoretical control engineering knowledge based on experiments and apply theoretical control engineering knowledge by means of experimental and simulation studies (3)
- analyse static and dynamic properties of controlled systems (3)
- create mathematical models of a specific system (2)
- determine model parameters experimentally (2)
- deal with analog and digital controllers

- use laboratory equipment for measurement and control engineering (2)
- proceed methodically when solving control engineering problems (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • work together in a team in the preparation, follow-up and implementation of practical experiments (2) • discuss control engineering issues in a team (3) • transfer knowledge of occupational safety to the active and passive execution of experiments (2) • critically evaluate the test results achieved (3)
Teaching materials offered
Script, manuals, course e-learning platform
Teaching media
Computer/projector, blackboard, PC for every participant
Literature
See literature list in the eRTP documents and in the eRTV script

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Einführung in CFD (Introduction to CFD)	CDF

Person responsible for the module	Faculty
Prof. Dr. Oliver Webel	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Mandatory requirements
Fluid Mechanics
Recommended previous knowledge
Mathematics for Engineers 1-3, Engineering Mechanics 1-3

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Einführung in CFD	4 SWS	5

Submodule	Submodule abbreviation
Einführung in CFD (Introduction to CFD)	**CFD**

Responsible person	Faculty
Prof. Dr. Oliver Webel	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Oliver Webel	only in summer semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam
Approved Aids for Evidence of Achievement
SHM (Standard tools, page2)

Content

- Introduction
- Computational grids
- Governing equations
- Finite-Volume Method
- Unsteady flows
- Turbulent, technical flows
- Analysis of a CFD-Simulation (error sources)
- Practical tutorials with ANSYS ICEM / Fluent

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- to gain a basic overview of CFD (1)
- to gain an overview of practical applications in CFD (1)
- to create basic computational grids with ANSYS ICEM (3)
- to conduct basic CFD-simulations including Post-Processing with ANSYS Fluent (3)
- to know about potential error sources and how to avoid (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • to know about the role of CFD in science and industry (2) • to work in interdisciplinary teams (3) • to use english language in the field of CFD (3)
Teaching materials offered
Lecture slides, tutorial slides
Teaching media
Computer/projector, blackboard
Literature
• Versteeg, Malalasekera: An Introduction to Computational Fluid Dynamics, 2nd edition, Pearson • Tu, Yeoh, Liu: Computational Fluid Dynamics – A practical approach, Butterworth-Heinemann • Ferziger, Peric, Street: Computational Methods for Fluid Dynamics, 4th edition, Springer

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Energy Efficiency in Buildings and Industry (Energieeffizienz in Gebäuden und Industrie)	eEE

Person responsible for the module	Faculty
Prof. Dr. Belal Dawoud	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Mandatory requirements
Successful in both TD1 und TD2 courses

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Energy Efficiency in Buildings and Industry (Energieeffizienz in Gebäuden und Industrie)	4 SWS	5

Submodule	Submodule abbreviation
Energy Efficiency in Buildings and Industry (Energieeffizienz in Gebäuden und Industrie)	**eEE**

Responsible person	Faculty
Prof. Dr. Belal Dawoud	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Belal Dawoud Prof. Dr. Johannes Eckstein	**every second semester
Teaching method	
Seminaristischer Unterricht und Übung	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Portfolio review
Approved Aids for Evidence of Achievement
SHM (c.f. page 2) and the actual published formulary in ELO, with hand-written remarks

Content

- Energy efficiency and the procedure of energy efficiency analysis
- Energetical evaluation of buildings as well as their different heating and heating distribution systems
- Estimation of the heating demands and the potentials to increase the energy efficiency in the heating sector.
- Common methodologies for estimating the heating load.
- Heat recovery and the Pinch theory
- Heat pumps and cooling systems
- Utilization methodologies and energetical assessment of combined energy systems based on heat pumps
- Estimation of the primary energy and CO2-emission reductions through combined heat and power cycles (CHP)
- Assessment of the energy efficiency of industrial processes

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- explain and discuss the energy efficiency and efficiency analysis methodologies (2)
- present and apply the energy conversion processes and their assessment routes (3)

- identify and discuss general measures for the rational energy use (2)
- apply a systematic approach to energy efficiency analysis to derive individual measures fort he rational utilization of energy and resources (3).
- carry our energy assessments of buildings and building's energy supply and distribution systems (3)
- identify measures to increase the energy efficiency in the heating sector (3)
- apply the Pinch-Theory in different energy processes and plants for estimating (2) and designing (3) different heat recovery concepts and quantifying their respective potentials (3).
- appraise heat pumps and cooling machines for different energy supply systems (2) and assess their economics (3)
- evaluate CHP systems in terms of energy, ecology, and economy (2) and to present for use in energy supply systems (3)Identify and analyze different measures to increase the energy egficiency in industry processes (3)
- identify and analyze different measures to increase the energy egficiency in industry processes (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- identify (1) and practice (2) the basic principles of teamwork and feedback rules
- discover and value own abilities as well as autonomously use the pertinent design and decision freedoms to further develop themselves under guidance (3)
- develop the increasing importance of the energy efficiency in the context of interdisciplinary projects in a professional self-image and to reflect on the consequences (3)
- critically reflect their professional actions in relation to social expectations and consequences (3)
- recognize the need to prepare themselves for a presence lecture (2)

Teaching materials offered

Books, Lecture slides, scientific papers, and technical data sheets of products

Teaching media

Computer/overhead projector, videos, visualizer, blackboard

Literature

- Fell H.-J.; Globale Abkühlung: Strategien gegen die Klimaschutzblockade – ökologisch, wirtschaftlich, erfolgreich, Beuth Verlag. 1. Auflage 2013.
- Quaschning V.; Erneuerbare Energien und Klimaschutz, 3. Auflage, Carl Hanser Verlag, München, 2013.
- Wesselak, V.; Schabbach, T.; Link, T.; und Fischer, J.; Regenerative Energietechnik, 2. Auflage, Springer Verlag, 2013
- M. Blesl, M. und Kessler, A., Energieeffizienz in der Industrie; Springer-Verlag Berlin Heidelberg 2013

More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Fundamentals of Electric Machines and Drives (Grundlagen der Antriebstechnik)	eGAT
Person responsible for the module	Faculty
Prof. Dr. Thomas Schlegl	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6	3	mandatory	5

Recommended previous knowledge
Setting up and solving linear differential equations with constant coefficients; • laplace transformation; • calculation of arithmetic mean values; • sold handling of complex numbers and complex calculation; • setting up and solving linear equations; • basic terms of electrical engineering; • solid handling of and calculating DC and single phase AC circuits w.r.t. electrical voltage, electrical current, electrical resistance and electrical power (active, reactive, apparent); • measuring electrical quantities (DC and AC); • calculation skills for electrical fields, electrical current and voltage; • material dependency of electrical field; • charging and discharging of capacitors; • calculation skills for magnetic field and magnetic flux; • knowledge about ferromagnetism; • calculation skills for magnetic force and induction; • calculating magnetic circuits; • rectify and invert DC and AC quantities; • solid handling of translatory and rotatory rigid body mechanical systems; • calculation of forces and torques; • setting up and solving equations of motion; • measuring kinematic quantities; • calculating kinematic and kinetic quantities over transmissions and gearboxes; • solid design and handling of basic closed-loop control systems; • describing and calculation linear dynamical systems in time domain and frequency domain; • knowledge about properties of linear dynamical systems in time domain and frequency domain; • analysing linear control loops w.r.t. stability and performance; • knowledge of basic methods for design and application of closed-loop control systems

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Fundamentals of Electric Machines and Drives (Grundlagen der Antriebstechnik)	4 SWS	5

Submodule	Submodule abbreviation
Fundamentals of Electric Machines and Drives (Grundlagen der Antriebstechnik)	**eGAT**

Responsible person	Faculty
Prof. Dr. Thomas Schlegl	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Franz Fuchs Prof. Dr. Thomas Schlegl	**every semester

Teaching method

- On-site teaching: seminar teaching (3 SWS) and Exercises (1 SWS)
- Teleteaching: instructional video clip-based teaching with weekly colloquium via video conferencing system (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam 90 min.
Approved Aids for Evidence of Achievement
Faculty standard aids (SHM) but no additional sheets of paper except one single sheet of paper featuring any written, drawn or printed content

Content

- Basic concepts of electric machines and drives and their application in mechanical engineering as well as automation engineering
- Drive trains: Design, desired motion, equations of motion, inertia, mechanical transmission, flow of power, transmission of velocities, forces, torques and mass moments of inertia
- Mechanics of drive trains: torque balance, steady-state and transient character, torque/ speed behaviour of drives and driven machines, stability of operating points, vibrations, optimal design of drive trains
- Alternating current (AC) systems: amplitude, frequency, phase, vector diagrams, active and reactive impedance, admittance and power, apparent resistance and power
- Three-phase AC systems: vector diagrams, complex calculation, rotating magnetic field, basic circuits for electrical generators and engines
- Single-phase and three-phase transformer, basics of frequency converters
- Electric drives: basics, classification according to static behaviour, thermal management, housing, protection
- DC engine: electric-mechanical structure, operating principle, descriptive equations, engine variants and their respective characteristics, means of changing static machine behaviour
- Three-phase asynchronous engine: electric-mechanical structure, operating principle, descriptive equations, engine variants and their respective characteristics, means of changing static machine behaviour, selected cases of operation
- Control of electric machines and drives: use cases, control architecture, characterization of closed-loop controlled machines, design and parameterization of an electrical current controller for DC engines, design and parameterization of rotational speed controller for DC engines, position control

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- understand, discuss and mathematically treat mechanical and electrical properties of drive systems (2)
- abstract, modularize and graphically represent drive systems (2)
- derive the equations of motions of driven machines and drive trains (3)
- calculate the mass moments of inertia as well as forces and torques across transmissions and gearboxes to any part within a drive train (3)
- describe the relationship between the intended behaviour of motion of a driven machine and the therefore necessary behaviour of drive and engine
- design or select drives considering load case and ambient conditions (2)
- to specifically change the behaviour of drive trains by adjusting electrical quantities (2)
- push drive trains to their optimal performance through closed-loop control of the engine (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- understand textually and/or graphically specified requirements for drive trains and develop engineering solutions to meet these requirements (2)
- discuss and provide solutions to complex engineering problems concerning drive trains (2)
- present investigation and/or computational results in technical meetings (1)
- understand modern drive technology as the main driving force for the transition to new mobility concepts for persons and goods (1)
- recognize the ethical implications of the application of engines and drives e.g. in robotics leading to the loss of jobs (2)

- asses the technological and ecological consequences of using engines and drives (1)
- grasp the socio-economical aspects of drive technology for the overall development the European societies (1)
- really hate the subject (3)

Teaching materials offered
Lecture notes, exercises, MATLAB code, Simulink models, instructional video clips (in case of teleteaching only)
Teaching media
eLearning platform, notebook, projector, video conferencing system (in case of teleteaching only)
Literature
An updated list of recommend reading is available on the eLearning platform of the module
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Fundamentals of FEM (Grundlagen der FEM)	eGFE

Person responsible for the module	Faculty
Prof. Dr. Marcus Wagner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
7	3	mandatory elective	5

Recommended previous knowledge
Engineering Mechanics 1, 2, 3

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Fundamentals of FEM (Grundlagen der FEM)	4 SWS	5

Submodule	Submodule abbreviation
Fundamentals of FEM (Grundlagen der FEM)	**eGFE**

Responsible person	Faculty
Prof. Dr. Marcus Wagner	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Valter Böhm Prof. Dr. Sebastian Dendorfer Prof. Dr. Aida Nonn Prof. Dr. Florian Nützel Prof. Dr. Marcus Wagner	only in winter semester

Teaching method

- Seminar teaching (SU) (2SWS),
- Practical course (Pr) (2SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment

Written exam, 90min

Approved Aids for Evidence of Achievement

SHM (Standard tools, page 2) without own writing paper, textbook "Wagner, M.: Linear and nonlinear FEM, Springer-Vieweg", printout of the exercise document. Short text-related entries, text markings and bookmarks for page marking are permitted.

Content

Introduction to the basics of the finite element method for elastostatics and dynamics

- displacement approach, shape function, stiffness and mass matrix
- characteristics and properties of simple finite elements
- procedure for the creation of simulation models:
- model creation, idealisation, discretisation, selection of suitable elements,
- meshing, boundary conditions, loads
- calculation: analysis types and options
- presentation and evaluation of simulation results. Error analyses
- insight into further applications of FEM: contact problems, non-linearities, temperature field analyses and coupled field problems

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • state the basics of the finite element method (1) • create simple FE simulation models (1) • use commercial FE software to solve simple simulation tasks (2)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • deal with English-language software and user manuals (2) • assess the limits of the FEM's predictive capability and the resulting risks and the resulting risks (3)
Teaching materials offered
Book [1], Software, Tutorials, Exercises
Teaching media
Computer/projector, blackboard
Literature
[1] Wagner, M.: Linear and nonlinear FEM, Springer-Vieweg
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Internal combustion engines (Verbrennungsmotoren)	eVB

Person responsible for the module	Faculty
Prof. Dr. Hans-Peter Rabl	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Internal combustion engines (Verbrennungsmotoren)	4 SWS	5

Submodule	Submodule abbreviation
Internal combustion engines (Verbrennungsmotoren)	**eVB**

Responsible person	Faculty
Prof. Dr. Hans-Peter Rabl	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Hans-Peter Rabl	**every second semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 min.

Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), without own writing paper, collection of formulae (1 DIN A4 sheet printed or written on as desired)

Content
• Possible applications and principles of combustion engines • Emission regulations (national, international) • Thermodynamics of the combustion engine (thermodynamic principles, engine combustion, gas exchange systems, turbocharging, heat release calculations) • (Alternative) fuels (fossil, biogenic, synthetic) • Formation and reduction of exhaust emissions (pollutant formation, pollutant reduction measures, exhaust gas aftertreatment systems, measurement technology) • Electronic engine control (engine control functions, engine operating states, sensors, actuators)
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • establish thermodynamic theorems for combustion engines, including for complex systems (1) and calculate thermodynamic state variables and changes (2) • analyse existing engines using thermodynamic comparative approaches (2) • analyse processes, components and assemblies for mixture formation, ignition, load control. combustion control and exhaust gas aftertreatment (1)

- evaluate mixture formation, ignition, combustion process, pollutant formation of existing technical solutions (3);
- describe mechanisms of action and laws (3); propose own design rules for new combustion processes (3)
- plan emission reduction processes (2) and derive methods to fulfil future requirements (3)
- analyse the interaction of different technical solutions, considering the requirements for torque, acoustics, consumption and emissions (3)
- design fundamental engine control functionalities, including actuators and sensors, taking into account requirements and boundary conditions (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- realistically assess their own level of knowledge in relation to the subject area (3)
- independently evaluate the contribution, significance and impact of combustion engines on individual mobility, energy supply, environmental impact and society (3)
- critically assess the role and potential of alternative fuels (including so-called e-fuels and biofuels) in the area of energy transition and sector coupling (3)
- develop technical solutions for compliance with current and future legal regulations for emissions and climate protection (3)

Teaching materials offered

z. B. Lecture handout

Teaching media

z.B. computer/projector, blackboard

Literature

- Lumley. J. L.: Engines – An Introduction. Cambridge University Press. 8th Ed. 2010.
- Heywood, J. B.: Internal Combustion Engines Fundamentals. Mc Graw Hill, 2nd Ed, 2018.

More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Laboratory Exercises: Plants and Engines (Maschinentechnisches Praktikum)	PMS

Person responsible for the module	Faculty
Prof. Dr. Andreas Ellermeier	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6	3	mandatory	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Laboratory Exercises: Plants and Engines (Maschinentechnisches Praktikum)	4 SWS	5

Submodule	Submodule abbreviation
Laboratory Exercises: Plants and Engines (Maschinentechnisches Praktikum)	**PMS**

Responsible person	Faculty
Prof. Dr. Andreas Ellermeier	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Johannes Eckstein Prof. Dr. Andreas Ellermeier Prof. Dr. Stefan Hierl Prof. Dr. Robert Leinfelder Prof. Dr. Andreas Lesser Prof. Dr. Thomas Lex Prof. Dr. Hans-Peter Rabl Prof. Dr. Sven Wassermann	**every semester

Teaching method
Laboratory Exercise

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
• Practical proof of performance • Attendance, 12 papers with certificate
Approved Aids for Evidence of Achievement
All

Content
• Practical training on systems, test benches and machines • Practical use of different test and measurement techniques • Use of computers (PC) for control, data acquisition and evaluation • Application of theoretical laws for the evaluation of measurement data • Presentation of the measurement results in curves or diagrams • Working with measured curves and characteristic diagrams • Discussion of the test results
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • prepare (2) and carry out (3) tests on different machines and systems. • record (2) and interpret (3) measurement data and document these in test reports (2)

- draw conclusions from the test results and theoretical knowledge about the investigated processes and systems (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • organize the execution and evaluation of the experiments independently in a team (2) • present (2) and discuss (3) the experimental results in front of the group
Teaching materials offered
E-Learning, handout, technical documentation
Teaching media
Computer/projector, blackboard, videos, PC
Literature
More information about the course
Assistance with the new formulation: • knowing (level 1) - e.g. naming, specifying, labeling, enumerating • ability (level 2) - e.g. use, execute, handle, select, construct, calculate, create, examine, build, design, plan, elaborate, compile • understanding and applying (level 3) - e.g. developing, analyzing, assessing, weighing, checking, criticizing, evaluating, evaluating, weighting, interpreting, estimating, recommending, suggesting, presenting, showing • these levels are added in brackets after the competencies.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Laser Based and Additive Manufacturing (Lasergestützte und Additive Fertigung)	LAF

Person responsible for the module	Faculty
Prof. Dr. Stefan Hierl	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Laser Based and Additive Manufacturing (Lasergestützte und Additive Fertigung)	4 SWS	5

Submodule	Submodule abbreviation
Laser Based and Additive Manufacturing (Lasergestützte und Additive Fertigung)	**LAF**

Responsible person	Faculty
Prof. Dr. Stefan Hierl	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Stefan Hierl	**every second semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 minutes
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content
• Design and working principles of lasers • Components for beam guiding and shaping • Laser processes: structuring, drilling, marking, cutting, welding and soldering • Additive manufacturing processes with and without lasers
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • select beam sources, beam guidance and shaping components for the above-mentioned applications (2) • essentially assess the possible applications and limitations of lasers for the above-mentioned processes (2) • essentially assess the possible applications and limitations of additive manufacturing processes (2)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to,

- assess the sensible use of lasers and additive manufacturing in industrial production technology (3)

Teaching materials offered
Presentation slides (excerpts), textbooks, scientific articles, information material from companies, patents, standards, exercises
Teaching media
z.B. computer/projector, blackboard, exhibits
Literature
Bibliography: see script

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Machine Dynamics (Maschinendynamik)	eMD

Person responsible for the module	Faculty
Prof. Dr. Marcus Wagner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6	3	mandatory	5

Recommended previous knowledge
Engineering Mechanics eTM3, Computer Science for Engineers eII

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Machine Dynamics (Maschinendynamik)	4 SWS	5

Submodule	Submodule abbreviation
Machine Dynamics (Maschinendynamik)	**eMD**

Responsible person	Faculty
Prof. Dr. Marcus Wagner	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Fredrik Borchsenius Prof. Dr. Carsten Schulz Prof. Dr. Marcus Wagner	only in summer semester

Teaching method
Seminar teaching (SU) (3SWS), Practical course (Pr) (1SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90min

Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), Printout of the formula collection. Text markings and bookmarks for page marking are permitted.

Content
Introduction to the basics of vibration technology: • visualisation of vibrations in the time and frequency domain • analytical and numerical calculation of vibrations with one and more degrees of freedom • treatment of free and forced vibrations • calculation of eigenvalues and eigenvectors • bending and torsional vibrations • measurement of vibrations, modal analysis • methods of analytical mechanics • numerical solution of time-dependent ODES with Matlab • measures for vibration reduction
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • state the basics of vibration theory and applied dynamics (1),

- analyse and calculate mechanical vibration problems (2),
- specify the basic methods of vibration measurement technology (1),
- create simple programmes with Matlab for the numerical solution of ODES (3),
- calculate eigenvalues and eigenvectors with Matlab (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- communicate with experts and non-specialists on subject-specific topics (2),
- develop and carry out vibration analyses in a team (3),
- categorise and evaluate different calculation and measurement methods (3),
- deal with English-language software and user manuals (2),
- describe the effects of vibrations (service life, noise, health hazards, etc.)(1).

Teaching materials offered

Lecture notes, formulary, Software, Tutorials, Exercises

Teaching media

Computer/projector, blackboard, exhibits, demonstrations

Literature

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Manufacturing of polymer products (Produktion mit Kunststoffen)	ePKV

Person responsible for the module	Faculty
Prof. Dr. Tobias Laumer	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Manufacturing of polymer products (Produktion mit Kunststoffen)	4 SWS	5

Submodule	Submodule abbreviation
Manufacturing of polymer products (Produktion mit Kunststoffen)	**ePKV**

Responsible person	Faculty
Prof. Dr. Tobias Laumer	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Tobias Laumer	only in winter semester

Teaching method

- Seminar teaching (SU)
- Practical course (Pr)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment

Portfolio exam

Approved Aids for Evidence of Achievement

SHM (Standard Tools, page 2)

Content

Basics of polymers
- polymer groups
- qualification of basic polymers and polymer products

Manufacturing technologies for polymers:

- injection moulding
- forming technologies
- joining technologies
- additive Manufacturing technologies

Design process of polymer products:

- basics of the design process
- potential and limitations of polymer products
- optimal choice of the manufacturing technology

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • choose the right polymer according to the requirements for a specific product (3) • choose the right manufacturing technologies and know the advantages and disadvantages of the different technologies (2) • know the limitations of important polymers according to their application (2) • qualify important polymer characteristics (e.g. thermal material properties) (2) • evaluate the interactions between process parameters and part properties of polymer parts (3)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • make decisions for using the adequate material according to their applications (2) • communicate their material and/or manufacturing technology choice within and without a company (3) • understand and communicate complex topics for the designing process with polymers and in general (3)
Teaching materials offered
Lecture handout, video units
Teaching media
Computer/projector, blackboard, CAD workstation
Literature
Oesterlie, S., et al.: Mechanical and Metal Trades Handbook, Europa Lehrmittel.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Material Flow Systems (Materialflusstechnik)	MFT

Person responsible for the module	Faculty
Prof. Stefan Galka	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Material Flow Systems (Materialflusstechnik)	4 SWS	5

Submodule	Submodule abbreviation
Material Flow Systems (Materialflusstechnik)	**MFT**

Responsible person	Faculty
Prof. Stefan Galka	mechanical engineering
Lecturer	Availability of module
Prof. Stefan Galka	**every second semester
Teaching method	
Seminar teaching (SU)	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam (60 Min)
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- The fundamental terminology, subject area of conveyor and material handling technology (MHS)
- the relevance and definition of material flow,
- The classification of material flow, structure, and analysis of material handling /conveying systems for internal transport processes
- Key performance indicators of MHS
- System elements: Systematics of the conveyed goods and loading carriers, formation of loading units and packaging
- Continuous conveyors (selection): Belt conveyors for bulk goods/packaged goods; non-continuous conveyors (selection):
- lifting equipment, storage and retrieval machines and components
- Influencing and planning parameters for the selection of MHS
- Design and planning of MHS (selection) using the example of an automated
- high-bay warehouse with picking zone
- Calculation of cycle times/performance for non-continuous conveyors (transfer cars, storage and retrieval machines)
- Order picking systems (manual systems)
- Forklift trucks (calculation of cycle time)
- Modeling of MHS, design of nodes: Merging and branching
- Tendering and acceptance procedure of MHS

Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • know the most important basic concepts, parameters and principles of MHS (1) • be able to calculate the relevant parameters for MHS (3) • ability to analyse, design and system-technical layout of conveyor systems, MHS and single system elements (3) • ability to calculate material flow matrix for MHS • ability to dimension material flow nodes (limit throughput equation) (3) • ability to design material flow systems in terms of throughput (2) • ability to carry out a material flow analysis or investigation (2) • ability to select suitable conveyor systems (2) • ability to break down a transportation process into sub-steps and evaluate them in terms of time evaluation with MTM (Methods-Time-Measurement) (3) • recognizing the effects and correlations between the technical design of materialof material flow systems and their control (2)
Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • work in groups (2) • present results to a group (2) • impact of increased automation in material handling processes on the working environment. (1) • necessity of safe and error-free planning of MHS, as this otherwise this has serious consequences for occupational safety (1)
Teaching materials offered
• Lecture handout • ELO-Learning-Platform
Teaching media
Computer/projector, blackboard
Literature
• Fottner, J, et al. Planung innerbetrieblicher Transportsysteme • Arnold, D.: Materialflusslehre, Vieweg Verlag • Martin, H.: Förder- und Lagertechnik, Vieweg Verlag • VDI-Handbuch: Materialfluss und Fördertechnik, Beuth, Köln • Pfeier, H.: Grundlagen der Fördertechnik, Vieweg • Reitor, G: Fördertechnik, Hanser.
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Microcontroller Based Process Control with Laboratory Exercises (Steuerungstechnik mit Praktikum Microcontroller)	eST

Person responsible for the module	Faculty
Prof. Torsten Reitmeier	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Recommended previous knowledge
eMA1/eMA2, eMTV, eRTV

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Microcontroller Based Process Control with Laboratory Exercises (Steuerungstechnik mit Praktikum Microcontroller)	4 SWS	5

Submodule	Submodule abbreviation
Microcontroller Based Process Control with Laboratory Exercises (Steuerungstechnik mit Praktikum Microcontroller)	**eST**

Responsible person	Faculty
Prof. Torsten Reitmeier	mechanical engineering
Lecturer	**Availability of module**
Prof. Torsten Reitmeier	only in winter semester

Teaching method
Seminar-based teaching (3 SWS), practical course (1 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam (90 min)
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2) without your own writing paper

Content

- Digital logic
- Logical operation functions
- -Truth tables, symbolism, standards
- Automation devices, types and properties
- State machines
- Microcontrollers, structure, function blocks
- Programming techniques
- Programming language: C (and individual assembler commands)

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- use logical functions, truth tables and symbols (2)
- design state sequence diagrams and state sequence tables (2)
- list the most important types of automation devices (1)
- name the most important components of a microcontroller and their functions (1)
- be able to work practically with a microcontroller (3).
- structure and implement a control task (3)
- apply basic knowledge of programming in “C” (2)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • use data sheets for microcontrollers (2) • design control engineering tasks in the field of tension between different disciplines and trades and to realistically assess their own level of knowledge in relation to the specialist field. (2) • recognize the opportunities and risks of control technology applications with regard to the safety relevance of systems and ethical aspects, e.g. protection of personal data. (3)
Teaching materials offered
Software, Compiler, IDE
Teaching media
Computer/projector, blackboard, PC for every participant
Literature
See literature list in the eST documents and in the eST script

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Motion Design and Mechanisms (Bewegungstechnik)	BTK

Person responsible for the module	Faculty
Prof. Dr. Thomas Schaeffer	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. od. 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Motion Design and Mechanisms (Bewegungstechnik)	4 SWS	5

Submodule	Submodule abbreviation
Motion Design and Mechanisms (Bewegungstechnik)	**BTK**

Responsible person	Faculty
Prof. Dr. Thomas Schaeffer	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Thomas Schaeffer	**every semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. od. 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 Min
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2), all handwritten and printed documents

Content

- Introduction to motion technology (mechanical mechanisms): Applications, examples, task of motion technology
- Motion design: Motion tasks (guidance motion and transfer function), laws of motion, impact and jerk
- Systematics of mechanisms: definitions, structure of mechanisms consisting of links and joints, kinematic chains, degree of freedom of joints and gears.
- Analysis of speeds, accelerations, forces and torques, plane motion, relative poles, pole paths, coupler curves
- Four-bar mechanisms: systematics, circulation conditions, special positions (dead point and limit positions)
- (Qualitative) structural and (quantitative) dimensional synthesis: catalogs, synthesis methods (e.g. 3-positons construction), numerical optimization
- Cam gears, step mechanisms: systematics, types, calculation, application

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- develop functional motion systems taking into account technical and economic framework conditions (3)
- describe motion tasks in a technically advantageous way and calculate them quantitatively (2)

- name the main types of mechanisms and motion systems (mechanisms, cammechanisms, step mechanisms, controlled drives) and their application (1)
- specify the possibilities and limitations of mechanical motion systems (mechanisms) (1)
- apply methods for the structural analysis and synthesis of mechanisms (2)
- use the methods for kinematic, static and dynamic analysis of mechanisms (2)
- build and calculate simulation models of planar mechanisms (3)
- evaluate simulation and calculation results of non-uniformly geared mechanisms (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- deal with VDI guidelines on the subject of motion technology (2)
- describe complex motion sequences in a standardized way and thus facilitate communication in the company between the development department and the calculation department (3)
- correctly assess the importance of mechanical motion systems in machines, vehicles, devices and systems as the components that essentially determine the performance of the system (3)

Teaching materials offered

Lecture notes, exercises, catalogs, standards, patents, software, tutorials

Teaching media

Exponates, computer/beamer, blackboard, videos

Literature

- Fricke, A.; Günzel, D.; Schaeffer, Th.: Bewegungstechnik Konzipieren und Auslegen von mechanischen Getrieben, 3. Auflage, Carl Hanser Verlag München, 2022
- For further reading see Lecture notes

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Numerically Controlled Machine Tools (Werkzeugmaschinen)	NCV

Person responsible for the module	Faculty
Prof. Dr. Andreas Ellermeier	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. od. 7.	3	mandatory elective	5

Recommended previous knowledge
eFV / FEV

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Numerically Controlled Machine Tools (Werkzeugmaschinen)	4 SWS	5

Submodule	Submodule abbreviation
Numerically Controlled Machine Tools (Werkzeugmaschinen)	**NCV**

Responsible person	Faculty
Prof. Dr. Andreas Ellermeier	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Andreas Ellermeier	only in summer semester

Teaching method
Seminaristic teaching (2 SWS), Exercise course (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. od. 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam, 90 Min
Approved Aids for Evidence of Achievement
SHM (Standard tools, see page 2), 1 handwritten, one-sided DIN A4 sheet

Content

- Machine tool components (frame, drives, measuring systems, NC control unit, tooling system, etc.) and their design-related technical differences
- Automation equipment for machine tools
- Methods for evaluating / comparing machine tools regarding their static and dynamic behavior
- Possibilities of process monitoring on machine tools
- Basics of manual and computer-aided NC-programming of machine tools
- Exercises: Calculation of power requirements of main and auxiliary drives
- Exercises: Manual NC programming

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- use the basic technical terminology (1)
- select suitable machine tool components regarding the required machine characteristics (2)
- determine the necessary controlled machine tool axes for the machining of selected component features (2)
- describe the methods for determining and comparing machine tools and their components (1) and evaluate the results (3); they have the basic technical competence to purchase machine tools (2)

- name the building blocks of an NC program (1) and create an NC program manually (2); they know the requirements for computer-aided NC programming (1)
- identify the problem areas along the CAD-CAM production process chain (1)
- calculate force and power requirements of main and auxiliary drives of machine tools for turning, milling and drilling (2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- interact successfully with manufacturing experts (2), solve problems in small teams (2) and discuss possible solutions with the group (3)
- recognize the role and significance of increasing automation and networking of production facilities for future ways of thinking and working in production (2)

Teaching materials offered

Lecture handout

Teaching media

Computer/projector, blackboard, videos, PC

Literature

- Kief, Hans B.; Roschiwal, Helmut A.: CNC-Handbuch. 30th edition. Carl Hanser Verlag, Munich, 2017. eISBN: 978-3-446-45265-7, Print ISBN: 978-3-446-45173-5
- Neugebauer, Reimund: Machine tools. Design, function and application of metal-cutting and metal-removing machine tools. Springer Vieweg Verlag, Berlin, 2012.' eISBN: 978-3-642-30078-3, Print ISBN: 978-3-642-30077-6

More information about the course

Assistance with the new formulation:

- knowing (level 1) - e.g. naming, specifying, labeling, enumerating
- ability (level 2) - e.g. use, execute, handle, select, construct, calculate, create, examine, build, design, plan, elaborate, compile
- understanding and applying (level 3) - e.g. developing, analyzing, assessing, weighing, checking, criticizing, evaluating, evaluating, weighting, interpreting, estimating, recommending, suggesting, presenting, showingThese levels are added in brackets after the competencies.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Power Plant Technology (Anlagen- und Kraftwerkstechnik)	AKT

Person responsible for the module	Faculty
Prof. Dr. Robert Leinfelder	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
7	3	mandatory elective	5

Mandatory requirements
Thermodynamics
Recommended previous knowledge
Heat transfer

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Power Plant Technology (Anlagen- und Kraftwerkstechnik)	4 SWS	5

Submodule	Submodule abbreviation
Power Plant Technology (Anlagen- und Kraftwerkstechnik)	**AKT**

Responsible person	Faculty
Prof. Dr. Robert Leinfelder	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Robert Leinfelder	only in winter semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam

Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Energy demand, energy conversion and social relevance
- Definitions of terms in the energy sector and energy supply in Germany
- Methods for calculating and presenting primary energy consumption
- Classification of conventional energy conversion plants in the overall energy supply in Germany
- Conservation of energy (1st law of thermodynamics)
- Irreversibility (2nd law of thermodynamics)
- Thermodynamic cycle processes of thermal engines
- Steam power plants
- Gas turbine power plants
- Combination of gas and steam turbine power plants (G&D power plants)
- Nuclear power plants

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- be familiar with energy conversion in general (1)
- handle thermodynamic principles of energy conversion in power plants (2)
- understand power plant structures, its main components, its design and technical significance

- understand properties of the fuels used, exhaust gas purification and disposal of used fuels (3)

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • acquire the competences mentioned in the introduction under "2. learning objectives" (see page 2 of the module handbook)
Teaching materials offered
Lecture handout
Teaching media
Computer/projector, blackboard
Literature
List of literature
More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Process-Simulation (Prozess-Simulation)	ePS

Person responsible for the module	Faculty
Prof. Dr. Thomas Lex	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Recommended previous knowledge
Thermodynamics 1/Thermodynamics 2/Fluid Mechanics

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Process-Simulation (Prozess-Simulation)	4 SWS	5

Submodule	Submodule abbreviation
Process-Simulation (Prozess-Simulation)	**ePS**

Responsible person	Faculty
Prof. Dr. Thomas Lex	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Thomas Lex	**every year

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Project paper
Approved Aids for Evidence of Achievement
SHM (Standard tool, page 2)

Content

Introduction to industrial process development
Process flow diagrams (PFD), piping and instrumentation flow diagrams (PID)
Stationary and transient continuous processes
Introduction to the Aspen Hysys and Apsen Plus process simulators
Apparatus modelling

- Heat exchangers
- Separators
- Expansion and compression machines
- Reactors

Methods for computer-aided calculation of material properties and state variables of pure substances and mixtures
Process analysis and efficiency

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- to design process, piping and instrumentation flow diagrams (2).
- to handle the Aspen Hysys and Aspen Plus industrial process simulators (2).

- to model stationary and dynamic simulations for energy and process engineering applications (2).
- to select suitable models for the simulation of equipment (2).
- to optimize processes regarding efficiency and controllability (3)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
- to recognize the possibilities of digitalization in process calculation (2).
- to assess the fundamental role of simulation in the energy transition (2).
- to present and discuss results in an open discussion (3).
- to deal with simulation-related issues in a structured, problem-oriented and targeted manner (3).

Teaching materials offered

Exercises, demonstration videos, manuals, how-to guides for self-study

Teaching media

z.B. computer/projector, blackboard, software, videos

Literature

- Haydary J.: Chemical Process Design and Simulation: Aspen Hysys and Aspen Plus Applications. 2019 Wiley AIChE
- Gmehling J., Kleiber M.: Chemical Thermodynamics for Process Simualtion. 2019, Wiley-VHC

More information about the course

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Project Work (Projektarbeit)	PA

Person responsible for the module	Faculty
Prof. Dr. Peter Gschwendner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6	3	mandatory	6

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Project Work (Projektarbeit)	4 SWS	6

Submodule	Submodule abbreviation
Project Work (Projektarbeit)	**PA**

Responsible person	Faculty
Prof. Dr. Peter Gschwendner	mechanical engineering
Lecturer	Availability of module
Fakultät Maschinenbau (LB)	**every semester

Teaching method
Project Work

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6	4 SWS	german/english	6

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	120 h

Method of assessment
Project work with presentation (40 minutes)
Approved Aids for Evidence of Achievement
All

Content

- Project organization, project structuring, project controlling
- Case study-oriented problem and goal analysis
- Data collection and presentation, weaknesses analysis
- Goal-oriented problem-solving in teams considering methodological, system technical, and value analysis approaches
- Systematic documentation of results and project presentation
- Learning Objectives: Professional Competence

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- flexibly apply interdisciplinary professional and methodological knowledge acquired during studies under guidance (3)
- use digital media for information retrieval (3)
- cooperate in team idea generation (2)
- systematically analyze specific problems, develop, evaluate, and implement solution variants (3)
- communicate effectively within the group and with external value chain partners (2)
- work scientifically in a team (2)
- present project results and findings (2)
- learning Objectives: Personal Competence

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • cooperate in a team, distribute tasks, and plan project execution (3) • independently and responsibly familiarize themselves with new topics (3) • recognize the importance of the development process for the economic value chain (3) • recognize the necessity of considering current scientific findings for resource-conserving and energy-efficient developments (3) • fundamentally understand ethical aspects and social sanctions regarding damage to life, health, and property caused by products (2) • offered Teaching Materials • project-specific working materials and textbooks
Teaching materials offered
Assignments, guidelines for writing the term paper, specialized literature, catalogs of semi-finished products and standard parts, standards, software, tutorials, CAD training materials, program manuals, exercises, patents
Teaching media
Overhead projector, blackboard, CAD workstation for each participant, calculation programs, exhibits, computer/projector, internet
Literature
Project-specific working materials and textbooks

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Renewable Energies (Regenerative Energien)	REN

Person responsible for the module	Faculty
Prof. Dr. Johannes Eckstein	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. od. 7.	3	mandatory elective	5

Recommended previous knowledge
Thermodynamics 1

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Renewable Energies (Regenerative Energien)	4 SWS	5

Submodule	Submodule abbreviation
Renewable Energies (Regenerative Energien)	**REN**

Responsible person	Faculty
Prof. Dr. Johannes Eckstein	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Johannes Eckstein	only in winter semester

Teaching method
Seminar-style teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. od. 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written Exam (90 min)
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

The lecture covers the following topics, with the focus varying due to temporal and political conditions:

- fundamentals of the energy industry, energy balancing, and CO2 emissions
- wind energy: yield forecasting, physical principles, and technical implementation
- hydropower: physical principles and technical implementation
- marine energy: tidal power, wave energy, and ocean thermal energy conversion
- solar energy: basic radiation physics and its computational capture
- utilization of solar energy through photovoltaics, solar thermal energy, and concentrating systems for electricity generation
- geothermal energy and environmental heat: deep geothermal energy, surface geothermal energy, and its technical use
- biomass: introduction, sources, and types of use (combustion, fermentation, biofuels, etc.)
- electricity market: utilization and role of renewable energies in the electricity market
- hydrogen: introduction to the production and use of hydrogen as the energy carrier of the future

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- learning important basic concepts of the energy industry and the structure of energy production and consumption (1)

- understanding the origin of and possible measures against the greenhouse effect (1)
- developing an overview of important technical processes for providing usable energy from renewable energy sources such as sun, wind, water, geothermal energy, biomass, and marine energy, as well as analyzing specific advantages and disadvantages (2)
- determining the computational yield forecast from solar radiation, wind energy, and shallow geothermal energy (3)
- evaluating the use of various plant concepts regarding efficiency, sustainability, and social acceptance (2)
- basic knowledge of the electricity market and future potential uses of hydrogen (1,2)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- assessing the impact of using different energy resources to meet energy demand from a technical and non-technical perspective (2)
- improving presentation skills through short presentations on current topics (3)
- enhancing argumentation skills in group discussions on energy economic and policy issues (2)

Teaching materials offered

Course notes + collection of formulae (via ELO-Download)

Teaching media

Computer, Projector, Black board

Literature

Recommendations / Literatur list via ELO download.

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Robotics (Robotik)	eROB

Person responsible for the module	Faculty
Prof. Dr. Thomas Schlegl	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Recommended previous knowledge
• Setting up and solving linear differential equations with constant coefficients; • Laplace transformation; • Calculation of arithmetic mean values; • Sold handling of complex numbers and complex calculation; • Setting up and solving linear equations; • Basic terms of electrical engineering; • Solid handling of translatory and rotatory rigid body mechanical systems; • Calculation of forces and torques; • Setting up and solving equations of motion; • mMeasuring kinematic quantities; • Alculating kinematic and kinetic quantities over transmissions and gearboxes; • Solid design and handling of basic closed-loop control systems; • Describing and calculation linear dynamical systems in time domain and frequency domain; • Knowledge about properties of linear dynamical systems in time domain and frequency domain; • Analysing linear control loops w.r.t. stability and performance; • Knowledge of basic methods for design and application of closed-loop control systems

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Robotics (Robotik)	4 SWS	5

Submodule	Submodule abbreviation
Robotics (Robotik)	**eROB**

Responsible person	Faculty
Prof. Dr. Thomas Schlegl	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Franz Fuchs Prof. Dr. Thomas Schlegl	

Teaching method
On-site teaching: seminar teaching (3 SWS) and Exercises (1 SWS) Teleteaching: instructional video clip-based teaching with weekly colloquium via video conferencing system (2 SWS)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam 60 min.
Approved Aids for Evidence of Achievement
Faculty standard aids (SHM) but no additional sheets of paper except one single sheet of paper featuring any written, drawn or printed content

Content

- Basic concepts and significance of robotics in mechanical engineering as well as production and automation technology
- Different types of robots: Manipulation systems, locomotion systems, teleoperation systems, emotional robots
- Spatial arrangement of objects using homogeneous coordinates; representation of orientation in space using rotation matrices, quaternions, Euler parameters and reduced angle sets
- Programming language formulation of action plans for robots
- Inner and outer transformations of a manipulator
- Parameterization of action plans using various methods with or without sensor support
- Derivation of a kinematic manipulator model following Denavit-Hartenberg guidelines
- Numerical, analytical and mixed calculation of inverse kinematics models of manipulators
- Path planning in joint and working coordinates
- Path planning for manipulators in restricted workspaces using 2D distance transformation
- Operating modes of manipulators
- Control architectures for closed-loop position and path control of manipulators using computed torque control
- Indirect and direct force control of manipulators; hybrid control; impedance control
- Abstraction and modularization of robot tasks using transformation graphs and formulation of natural/artificial constraints

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- quantify manipulatory properties as well as locomotion properties of robot systems (2)
- abstract, modularize and graphically represent robot tasks for production and automation systems (3)
- analyse and synthesize use cases for robot systems using computer-aided engineering tools (3)
- methodically create and parameterize action plans for robots (2)
- expand the manipulatory capabilities of robots by integrating imaging and haptic sensors (1)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- deal with textually and/or graphically specified application cases of robots (2)
- understand data sheet specifications for robots (2)
- develop robot-supported solutions for complex production and automation tasks in a team (1)
- present analysis and design results on robotics-related topics in a technical discussion (1)
- recognize the central importance of robotics for securing the future of industrial production in Europe (1)
- understand robotics as a driver of the work transition in the context of Industry 4.0 (1)
- assess the technological consequences of the use of actuators and sensors, such as the release of low-skilled workers for higher-value professional tasks (1)
- recognize ethical implications of the use of robots, such as more low-skilled unemployed (1)
- to penetrate the socio-economic aspects of robotics for the overall development of society in Europe (1)

• really hate the subject (3)
Teaching materials offered
Lecture notes, exercises, MATLAB code, Simulink models, instructional video clips (in case of teleteaching only)
Teaching media
eLearning platform, notebook, projector, video conferencing system (in case of teleteaching only)
Literature
An updated list of recommend reading is available on the eLearning platform of the module

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Surface Engineering (Oberflächentechnik)	OT

Person responsible for the module	Faculty
Prof. Dr. Ulf Noster	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Surface Engineering (Oberflächentechnik)	4 SWS	5

Submodule	Submodule abbreviation
Surface Engineering (Oberflächentechnik)	**OT**

Responsible person	Faculty
Prof. Dr. Ulf Noster	mechanical engineering
Lecturer	**Availability of module**
Prof. Dr. Helga Hornberger Prof. Dr. Ulf Noster	only in winter semester

Teaching method
Seminar teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	german	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Basics of electrochemical and chemical (high temperature) corrosion, construction of electrochemical corrosion systems.
- Functional separation of material volume and material surface in the context of surface technology.
- Influence of corrosion and surface treatment on the service life (fatigue properties) of components.

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- describe the different types of corrosion, e.g. contact corrosion, pitting, stress corrosion cracking (1).
- use various methods of corrosion testing (2) and evaluations (3).
- describe the behaviour of components with graded (locally different) material properties under mechanical loads (1) and evaluate them (2).
- list possibilities for influencing component surface layers (1).
- select methods for testing component surfaces (2) and evaluate the results (3).
- select procedures for influencing component surfaces (surface layers) by mechanical, thermal and chemical effects, e.g. manufacturing, shot peening, case hardening, local cold work, residual stresses, recommend the optimal procedure (3) and estimate its impact (3).

Learning objectives: Personal competence
After successful completion of the submodule, students are able to, • deal with technical terms from the field of corrosion and surface technology (1) and to discuss these topics with both experts and non-experts (2). • to work out solutions with experts and interdisciplinary project teams (2), to evaluate these (3) and to evaluate their effects after implementation (3). • to evaluate both technical aspects (3) and the effects on resources and the environment (3).
Teaching materials offered
Lecture handouts at the e-learning platform
Teaching media
Beamer, blackboard
Literature
Given at first lesson

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Welding Technology (Schweißtechnik)	eSWV

Person responsible for the module	Faculty
Prof. Dr. Wolfram Wörner	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
6. or 7.	3	mandatory elective	5

Recommended previous knowledge
eWTK

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Welding Technology (Schweißtechnik)	4 SWS	5

Submodule	Submodule abbreviation
Welding Technology (Schweißtechnik)	**eSWV**

Responsible person	Faculty
Prof. Dr. Wolfram Wörner	mechanical engineering
Lecturer	Availability of module
Prof. Dr. Wolfram Wörner	**every year

Teaching method
Seminaristic teaching (SU)

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
6. or 7.	4 SWS	english	5

Study hours required

Hours in attendance/lectures	Hours for self-study
60 h	90 h

Method of assessment
Written exam
Approved Aids for Evidence of Achievement
SHM (Standard tools, page 2)

Content

- Overview of joining processes
- Welding processes
- Weldability of materials
- Weld-Testing
- Quality management in welding
- Operational Safety and Health in welding operations

Learning objectives: Subject competence

After successful completion of the submodule, students are able to,

- assess the suitability of different materials for welding (3)
- select suitable welding processes for different applications (2)
- work with current welding standards (2)
- contribute substantially to the creation of safe welded constructions, taking into account: technical, economic and ecological boundary conditions.

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,

- realistically assess their own level of knowledge in relation to the technical of technology (3)
- recognise the role and importance of welding technology in the technical environment (2)

- assess the consequences of the application of welding processes (3)

Teaching materials offered
z.B. Lecture handout, https://elearning.hs-regensburg.de/course/view.php?id=2918
Teaching media
z.B. computer/projector, blackboard
Literature
Library

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application

Module title	Module code
Presentation and Moderation (Präsentation und Moderation) (Presentation and Moderation (Präsentation und Moderation))	PMO

Person responsible for the module	Faculty
Heidrun Ellermeier (LB)	mechanical engineering

Semester taught according to the curriculum	Level of study	Module type	Credit value
7.	3.	mandatory	2

Mandatory requirements
keine
Recommended previous knowledge
keine

Content
siehe Teilmodul

Assigned submodules

Nr.	Submodule title	Teaching hours	Credit value
1.	Presentation and Moderation (Präsentation und Moderation)	2 SWS	2

Submodule	Submodule abbreviation
Presentation and Moderation (Präsentation und Moderation)	**PMO**

Responsible person	Faculty
Heidrun Ellermeier (LB)	mechanical engineering
Lecturer	**Availability of module**
Heidrun Ellermeier (LB) Prof. Dr. Claudia Hirschmann Eric Schönfeld (LB)	**every semester
Teaching method	
seminar	

Semester taught according to the curriculum	Teaching hours	Teaching language	Credit value
7.	2 SWS	german	2

Study hours required

Hours in attendance/lectures	Hours for self-study
30 h	30 h

Method of assessment
Presentation 15 min. **15-minute presentation on a topic from the field of soft skills, including the creation of a corresponding 3-5-page presentation document.**
Approved Aids for Evidence of Achievement
all

Content
• Communication: Communication models, communication structures and communication difficulties, targeted communication • Moderated meetings: Moderation methods; documentation of results and measures • Presenting: Target group analysis, structuring content, visualizing presentation content (e.g., PowerPoint slides, flipchart papers, posters), use of appropriate media in presentations • Personal appearance: Body language, demeanor • Language: Rhetoric • Soft skills: Requirements in everyday business life
Learning objectives: Subject competence
After successful completion of the submodule, students are able to, • Recognize congruent communication (1) • Understand misunderstandings in communication (2) and formulate measures to improve communication (3)

- Conduct target group analyses (3) and design the presentation process in a targeted manner (3)
- Select (2) and design (2) appropriate visualizations
- Describe important soft skills in everyday working life (1)

Learning objectives: Personal competence

After successful completion of the submodule, students are able to,
- Develop a confident manner (3)
- Present work results individually and as part of a team in a targeted manner (2)
- Assess your personal role in various conversation situations (2)
- Adapt your behavior to the communication requirements (3)

Teaching materials offered

script

Teaching media

Computer/projector, blackboard, video, overhead projector, flipchart

Literature

- Allhoff, Dieter-W. (2010): Rhetoric & Communication. A Textbook and Workbook. Reinhardt: Munich.
- Edmüller, Andreas & Wilhelm, Thomas (2015): Moderation. Haufe: Planegg/Munich.
- Seifert, Josef W. (2010): Moderation & Communication. Group Dynamics and Conflict Management in Moderated Groups. GABAL: Offenbach.
- German Managers' Association (2004): Soft Skills Handbook 1-3. vdf Hochschulverlag: Zurich.

More information about the course

see ELO

The numbers in brackets indicate the levels to be reached: 1 - understanding 2 - ability 3 - understand and application