2025

# Module Handbook

MECHATRONICS ENGINEERING

## Semester 1



## Semester 2



## Semester 3

## Semester 4



## Semester 5



## Semester 6



## Semester 7

## Module Number: 87001 SPO-Version: 34

## Mathematics 1

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Holger Schmidt |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 90 Hours |
| **Workload Self-Study** | 60 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students can apply the fundamentals of analysis, linear algebra and methods of scientific computing: They can formulate basic engineering problems mathematically and work on them systematically using suitable methods. They are also able to interpret results in the context of the task.

**Interdisciplinary Competence**

Students are able to solve exercises in groups and discuss different solutions. They can present their results to others.

**Course Content**

Fundamentals of analysis (elementary function, differential and integral calculus, Taylor series, sequences/series)

Fundamentals of linear algebra (systems of equations, vector spaces, matrices, eigenvalues/eigenvectors)

Complex numbers and complex functions

Introduction to scientific computing with Python (NumPy/SciPy, MatPlotLib, Sympy)

**Literature**

Lecture notes and Jupyter notebooks for the lecture

S. Boyd, *Introduction to Applied Linear Algebra*, Cambridge University Press

K. A. Stroud, *Engineering Mathematics*, Red Globe Press

K. A. Stroud, *Advanced Engineering Mathematics*, Red Globe Press

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[1] | SWS | CP |
|---|---|---|---|---|---|
| 87101 | Mathematics 1 | Prof. Dr. Holger Schmidt | V,Ü | 6 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[2] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87101 | PLK (120 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**
Successful participation in the exercises

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Holger Schmidt

[1] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[2] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 88001 SPO-Version: 34

## Engineering Mechanics 1

| | |
|---|---|
| **Degree Program** | Mechanical Engineering (B.Eng.) |
| **Module Manager** | Prof. Dr. Miranda Fateri |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | N.A |
| **Use in other SG** | Mechatronics Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students will be able to analyze forces and moments (planar and spatial) for mechanical tasks in statics. They can determine the center of gravity of complex objects and draw free-body diagrams for complex systems. They will be able to analyze the Equilibrium equations. Moreover, they can perform analytical calculations of support reactions, including those for trusses. Additionally, they will be able to analyze internal normal and shear forces, as well as bending moment diagrams of beams. Furthermore, they can analyze and apply the principles of friction and hydrostatics.

**Interdisciplinary Competence**

Students are able to work on given tasks in small teams both within and outside of tutorials. Additionally, students can complete graded and ungraded quizzes throughout the entire semester, individually and in teams.

**Course Content**

Basic definitions
Description of vectors, force, moment in Cartesian coordinate systems
Components of a force and the resultant force for a system
Center of gravity
Equilibrium
Degrees of freedom and support reactions
Beam internal forces and moments
Truss
Friction
Introduction to Hydrostatic

**Literature**

**English**:

Engineering Mechanics: Statics, J. L. Meriam, L. G. Kraige, John Wiley & Sons Inc; 7th edition (2011)

Engineering Statics: Open and Interactive, D. W. Baker, W. Haynes, 2020.

**German:**

Technische Mechanik Teil 1 Elastostatik - Gross, Hauger, Schröder, Wall, Springer Verlag Berlin Heidelberg New York Technische Mechanik 1 Statik –

Russell C. Hibbeler, Pearson Studium 2018 Technische Mechanik. Statik; Lehrbuch mit Praxisbeispielen - Richard, Hans Albert, Sander, Manuela 2008

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[3] | SWS | CP |
|---|---|---|---|---|---|
| 88101 | Engineering Mechanics 1 | Prof. Dr. Miranda Fateri | V | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[4] | Determination of Module Grades | Comments |
|---|---|---|---|
| 88101 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

*N.A*

**Further Study-Related Feedback**

*N.A*

**Comments**

-

**Last Update**: 17.06.2024, Prof. Dr. Miranda Fateri

[3] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

[4] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87002 SPO-Version: 34

## Material Science

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Rainer Börret |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**General**

**Professional Competence**

Students can describe the mechanical, electrical and optical properties of the various materials and are able to select the appropriate material for an application (e.g. optics, housing, circuit board). Students will be able to select materials on the basis of an engineering calculation in which they can determine whether the material properties fulfil the respective requirements.

**Interdisciplinary Competence**

Students can communicate in technical English and use the relevant material science and engineering vocabulary.

The exercises take place in small groups, so students can train their interdisciplinary skills while working in teams. Results can be presented to the other groups and discussed.

**Course Content**

- Atomic models
- crystal structures
- mechanical properties of materials
- failure
- Electrical properties of materials
- optical properties of materials
- phase diagrams

**Literature**

Recommendation:

William D. Callister Jr., David G. Rethwisch: Materials Science and Engineering, Wiley

Slides, Exercises on Canvas

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[5] | SWS | CP |
|---|---|---|---|---|---|
| 87102 | Material Science | Rainer Börret | V | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[6] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87102 | PLK (60 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

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**Further Study-Related Feedback**

-

**Comments**

none

**Last Update**: 04.07.2024, Prof. Dr. Rainer Börret

[5] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

[6] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87003 SPO-Version: 34

## German as a Foreign Language 1

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Miguel Vázquez, Head of Language Center |
| **Modul Type** | Mandatory Module for international students |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | Lecture |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | Formal: none<br>Content: none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English and German |

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**Module Objectives**

**General**

This course, based on CEFR level A.1.1, is intended for students with no previous knowledge of the German language. Task-based teaching and other classroom activities, including individual group work and compulsory homework, will provide a variety of the basic techniques to use the main vocabulary and grammar of the language. At the end of the course they will be able to talk about themselves and their areas of study and ask others about personal details, work, hobbies, and interests. The students will be able to use simple sentences and expressions in daily life situations and will be able to interact in a simple way provided the other person talks slowly and is prepared to help (see also CEFR https://www.coe.int/en/web/common-european-framework-reference-languages/the-cefr-descriptors). Course material will be provided by the library, the lecturer and the Language Center.

**Professional Competence**

Students will demonstrate a good level of communication and empathy and will master interactions with other people.They will develop an awareness of social and cultural conditions enabling them to act appropriately in complex situations Students are able to apply strategies and methods for the formation and maintenance of networks in this area.

**Interdisciplinary Competence**
This course involves the integration of basic cultural, linguistic, geographical, and social studies to enhance learning. Students are introduced to German-speaking countries' customs, holidays, and traditional foods. They compare simple vocabulary and sentence structures between German and English or their native language. Geography lessons include identifying major German-speaking countries and cities on a map. Literature and music exposure involves reading stories and listening to German songs. Technology integration uses language learning apps and watching short German clips with subtitles (e.g. within Speexx). Role-playing helps practice everyday communication like greetings and ordering food. Social studies cover typical daily routines and school systems in Germany. Basic business etiquette includes learning formal greetings and simple business customs. This approach provides a well-rounded, contextual introduction to the German language and culture.

**Course Content** See description above.

**Literature** DaF Kompakt neu, Klett Verlag, Script

**Included Courses** (LV)

| LV-Nr. | Course Name | Lecturer | Type[7] | SWS | CP |
|---|---|---|---|---|---|
| 87103 | German as a Foreign Language 1 | Behzad Moini | Ü, S | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[8] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87103 | PLK (90 Minutes) | 100% - not graded | |

**Requirements for Admission to the Module Exam**
Participation in Practical Training, 70% of attendance

**Further Study-Related Feedback**

**Comments**
Mandatory module for international students at A1.1-level

**Last Update**: 15.07.2024, Miguel Vázquez, Head of Language Center

[7] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[8] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87003 SPO-Version: 34

## Technical English 1

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Miguel Vázquez, Head of Language Center |
| **Modul Type** | Mandatory Module for German students |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | Lecture |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 30 Hours |
| **Workload Self-Study** | 120 Hours |
| **Participation Requirements** | Formal: none<br>Content: none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**General**

This course is designed to support the receptive and productive skills of technical language competencies across four skills: speaking, listening, reading and writing at the reference level B2.2 of the Common European Framework of Reference for Languages.

Students will be better able to understand the main content of technical texts and discussions from different subject areas and to communicate spontaneously in interdisciplinary contexts.

A range of topics will provide the framework for the application of oral and written communicative competency.

Autonomous work outside the class as well as active in-class participation, interaction and feedback will be expected in class. To successfully complete the course, students will need to complete collaborative in-class assignments, submit coursework and give a presentation.

The course consists of two modules.

In Module 1 we will focus on the revision of grammar structures in a technical context. New vocabulary and expressions will be explained and applied. The vocabulary is presented in authentic texts and credible scenarios, ensuring maximal practicality for the students.

In the second semester students will have the opportunity to practice both written and oral communication skills.

Teaching materials related to the students' major fields of study form the framework for the development and application of further, often subject-specific language skills, (that) are required for effective language competence in the technical field.

In addition, more complex technical forms of written and oral communication are analyzed and actively produced.

**Professional Competence**

Professional competence (social skills und ability to work independently): Students must demonstrate a high level of communication and empathy in their professional life.

Therefore, successful interactions with other people are practiced in a task-based training. The development of an awareness of social and cultural conditions with the goal to act appropriately in complex situations constitute another important block in this lecture. Students will learn strategies and methods for the formation and maintenance of networks in this area.

**Interdisciplinary Competence**

Mandatory module for international students at A1.1-level

**Course Content** See description above.

**Literature** Script, Books: Vocabulary and Grammar (Nick Brieger, Alison Pohl - Summertown Publishing Ltd.)

**Included Courses** (LV)

| LV-Nr. | Course Name | Lecturer | Type[9] | SWS | CP |
|---|---|---|---|---|---|
| 87104 | Technical English 1 | Doris Düwel | Ü, S | 2 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[10] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87104 | PLK (90 Minutes) | 100% - Not graded | |

**Requirements for Admission to the Module Exam**

Participation in Practical Training, 70% of attendance

**Further Study-Related Feedback**

**Comments**

Mandatory module for German students at B2.1-level

**Last Update**: 15.07.2024, Miguel Vázquez, Head of Language Center

[9] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[10] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87004 SPO-Version: 34

## Computer Science 1

| | |
|---|---|
| **Degree Program** | Computer Science 1 (B. Eng.) |
| **Module Manager** | Prof. Dr. Stefan Hörmann |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students will be able to

- apply basic structures and details of the Python programming language, in particular control structures, variables, simple data structures, dealing with objects and structuring with the help of methods.
- independently develop small, executable Python programs according to precise, textual specifications.
- analyze and evaluate Python programs.

**Interdisciplinary Competence**

By carrying out the programming exercises in teams of two, students are able to solve tasks together and work as a team.

**Course Content** Structure, syntax and formatting of Python programs
Types, values, variables, constants
Lists, sets
Objects and classes
Operators
Control structures
Methods
Visibility and validity of variables
Recursion, call hierarchy
References
Input/output
Interactive console applications
Programming elementary algorithms (sorting procedures or math formulas)
Analysis of programs in the debugger

**Literature**
M. Lutz, *Learning Python*, O'Reilly Media
D. Beazley and B. Jones, *Python Cookbook*, O'Reilly Media
E. Matthes, *Python Crash Course*, No Starch Pres

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[11] | SWS | CP |
|---|---|---|---|---|---|
| 87105 | Computer Science 1 | Prof. Dr. Stefan Hörmann | V,Ü | 4 | 5 |

**Mo5dule Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[12] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87105 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**
Successful participation in the programming exercises

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Stefan Hörmann

[11] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[12] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 88002 SPO-Version: 34

## 3D-CAX

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Markus Merkel |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 1. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

**Module Objective**

**Professional Competence:**

The students are able to define 3D geometry guided by the idea of the digital product development process. They will be able to use a 3D-CAD system for engineering applications. They are proficient in designing individual components and assemblies. The students can extract technical drawings out of 3D-CAD systems.

They are capable of describing the individual steps in the development process systematically and methodically (e.g., CAD-CAE, CAD-CAM, CAD-MKS, CAD-VR, CAD-RE process chain). Additionally, students will be able to discuss and evaluate complex organizational relationships within the context of virtual product development.

**Interdisciplinary Competence ("social competence" and "independence"):**
The students develop social competencies independently, as a part of a team and are able to apply their acquired technical knowledge in an interdisciplinary context.

**Course Content**

- Fundamentals of computer-aided product development
- Surface modeling, volume description;
- Lifecycle engineering, virtual engineering, collaborative engineering
- Virtual reality, Digital twin
- Digital Mock Up
- Simulation in the CAD environment
- Model-based definition with ISO-GPS
- Generative Design, Knowledge-based engineering
- CAD/CAM software and hardware
- PDM/PLM systems
- Coupling CAD/CAE
- Reverse engineering

3D-CAD designing: Building 3D geometry by3D-CAD solid modeler, transferring individual components into assemblies, Extracting Drawings, production documents, Surface modeling

**Literature**


- Coticchia, M. E., Crawford, G. W., Preston, E. J. (1993). CAD/CAM/CAE Systems: Justification, Implementation, Productivity Measurement, Second Edition, Hongkong: Taylor & Francis.
- Advances in CAD/CAM/CAE Technologies. (2020). Schweiz: MDPI AG.
- Sendler, U. (2013). CAD & Office Integration: OLE for Design and Modeling. A New Technology for CA Software. Deutschland: Springer Berlin Heidelberg.


**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[13] | SWS | CP |
|---|---|---|---|---|---|
| 88102 | CAD/CAE/CAM | Prof. Dr. Markus Merkel | V | 2 | 5 |
| 88103 | 3D-CAD | Prof. Dr. Markus Merkel | L, Ü | 2 | |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[14] | Determination of Module Grades | Comments |
|---|---|---|---|
| 88102 | PLK 60 Minutes | 50% | |
| 88103 | PLL 60 Minutes | 50% | During the semester |

**Requirements for Admission to the Module Exam**

PLL passed.

[13] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

[14] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Further Study-Related Feedback**

**Comments**

none

**Last Update**: 19.07.2024, Prof. Dr. Markus Merkel

## Module Number: 87005 SPO-Version: 34

## Mathematics 2

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Holger Schmidt |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 90 Hours |
| **Workload Self-Study** | 60 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students can apply in-depth knowledge of analysis, linear algebra and methods of scientific computing. They can formulate in-depth engineering problems mathematically and work on them systematically using suitable methods. They are also able to interpret results in the context of the problem.

**Interdisciplinary Competence**

Students are able to solve exercises in groups and discuss different solutions. They can present their results to others.

**Course Content**

Multidimensional analysis

Vector analysis

Ordinary differential equations and systems of differential equations: Analytical and numerical solution methods

Fourier series

Fourier and Laplace transforms

Specialization in Scientific Computing

**Literature**

Lecture notes and Jupyter notebooks for the lecture

S. Boyd, *Introduction to Applied Linear Algebra*, Cambridge University Press

K. A. Stroud, *Engineering Mathematics*, Red Globe Press

K. A. Stroud, *Advanced Engineering Mathematics*, Red Globe Press

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[15] | SWS | CP |
|---|---|---|---|---|---|
| 87201 | Mathematics 2 | Prof. Dr. Holger Schmidt | V,Ü | 6 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[16] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87201 | PLK (120 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

Successful participation in the exercises

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Holger Schmidt

[15] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[16] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 88003 SPO-Version: 34

## Electrical Engineering

| | |
|---|---|
| **Degree Program** | Mechanical Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Jens Krotsch |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | Formal: None<br>Content: Solid basic mathematical knowledge, differential and integral calculus, complex numbers, and good basic understanding of physics. |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students can describe the fundamental concepts of electrical engineering and relevant electrical quantities, are able to name and explain important components of electrical circuits and can express their properties mathematically. They can describe the basic circuit calculation methods, the basics of circuit simulation and can apply these to direct current, alternating current and three-phase circuits. The students are able to analyze and adapt simple electrical networks with stationary and non-stationary quantities.

The students can classify the dangers of electrical voltage and current and are aware of the responsibility involved in dealing with electricity.

**Interdisciplinary Competence**

The students are able to proceed methodically and to critically question results.

**Course Content**

- Basic concepts and electrical quantities
- Direct current (DC) circuits: conductors, current density, ideal and linear sources, basics of circuit analysis, nonlinear resistors, measurement of electr. quant., circuit simulation
- Alternating current (AC) circuits: components, RMS, vector representation, calculation using complex numbers, apparent, active and reactive power
- Multiphase AC systems and transformers

**Literature**


- J. Krotsch; *Comprehensive lecture notes*, Aalen University of Applied Sciences
- F. Hüning; *Fundamentals of Electrical Engineering for Mechatronics*, De Gruyter
- V. Hacker and C. Sumereder; *Electrical engineering: fundamentals*, De Gruyter
- Y. Singh and M. Verma; *Fundamentals of Electrical Engineering*, Laxmi
- S. A. Reza Zekavat; *Electrical Engineering: Concepts and Applications*, Pearson

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[17] | SWS | CP |
|---|---|---|---|---|---|
| 88201 | Electrical Engineering | Prof. Dr. Jens Krotsch | V,Ü,L | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[18] | Determination of Module Grades | Comments |
|---|---|---|---|
| 88201 | PLK (90 Minutes) | 100% | Permitted aids: Pocket calc. and formula sheet |

**Requirements for Admission to the Module Exam**

Successful completion of tests accompanying the lectures, e.g. evaluated Canvas quizzes and exercises.

**Further Study-Related Feedback**

None

**Comments**

None

**Last Update**: 05.08.2024, Prof. Dr. Jens Krotsch

[17] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[18] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 88004 SPO-Version: 34

## Engineering Mechanics 2

| | |
|---|---|
| **Degree Program** | Mechanical Engineering (B.Eng.) |
| **Module Manager** | Prof. Dr. Miranda Fateri |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Sommer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | Formal: Completed Engineering Mechanics 1 |
| **Use in other SG** | Mechatronics Engineering |
| **Language** | English |

**Module Objectives**

**Professional Competence**

The students can calculate the mechanical stress of statically determined elastic components and simple assemblies taking into account the tensile, compressive, shear, torsion and bending loads. Students will be able to analyze the problems regarding the state of stress (uni and biaxial loading conditions) and generalized law of elasticity.

**Interdisciplinary Competence**

Students are able to work in a team while solving exercises. They can also use the theoretical procedures for understanding the practical applications. They will be able to connect and address the questions of other courses such as construction of elements. The students are able to present their own solutions concisely. They can conduct assignments and quizzes on their own and also in a team. They can also discuss the industrial application of theoretical studies in teams.

**Course Content**

Normal Strain under Axial Loading
Stress-Strain Diagram
True Stress and True Strain
Hooke's Law; Modulus of Elasticity
Elastic versus Plastic Behavior of a Material
Poisson's Ratio
Uniaxial stress conditions: Tensile, Compression, Shear, Torsion and Bending
Generalized Hooke's Law Transformations of Stress and Strain
Principal Stresses: Construction of Mohr's Circle (biaxial stress)
General State of Stresses in Thin-Walled Pressure Vessels
Equivalent Stresses, Combined Loading Conditions

**Literature**

English:

Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf, David F. Mazurek Gross, Hauger, Schröder, Wall, Wriggers; (2014) Mechanics of Materials - McGraw-Hill Education

D. K. Singh, (2014) Strength of Materials – CRC Press, ISBN-10: 9781482245714

German:

Altenbach, Holm (2016): Holzmann/Meyer/Schumpich Technische Mechanik Festigkeitslehre. Wiesbaden: Springer Fachmedien Wiesbaden

Arndt, Klaus-Dieter; Brüggemann, Holger; Ihme, Joachim (2021). Festigkeitslehere für Wirtschaftsingenieure: Springer, eBook ISBN
978-3-658-33548-9

Technische Mechanik. Statik - Reibung - Dynamik - Festigkeitslehre - Fluidmechanik. 32. Aufl. 2017. Wiesbaden, s.l.: Springer Fachmedien Wiesbaden. Online verfügbar unter http://dx.doi.org/10.1007/978-3-658-16203-0.

Hauger, Werner; Krempaszky, Christian; Wall, Wolfgang A. (2017): Aufgaben zu Technische Mechanik 1–3. Statik, Elastostatik, Kinetik. 9. Aufl. 2017. Online verfügbar unter http://dx.doi.org/10.1007/978-3-662-53344-4.

Johannes Wandinger (2018): Technische Mechanik 1-3. Online verfügbar unter http://wandinger.userweb.mwn.de/index.html?101, zuletzt aktualisiert am 30.01.2018.

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[19] | SWS | CP |
|---|---|---|---|---|---|
| 88202 | Engineering Mechanics 2 | Prof. Dr. Miranda Fateri | V, L | 4 | 5 |

[19] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[20] | Determination of Module Grades | Comments |
|---|---|---|---|
| 88202 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

*N.A*

**Further Study-Related Feedback**

*N.A*

**Comments**

none

**Last Update**: 18.06.2024, Prof. Dr. Miranda Fateri

[20] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87006 SPO-Version: 34

## German as a Foreign Language 2

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Miguel Vázquez, Head of Language Center |
| **Modul Type** | Mandatory Module for international students |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | Lecture |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | Formal: German as a Foreign Language 1<br>Content: none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English and German |

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**Module Objectives**

**General**

This course, based on CEFR level A.1.2, is intended for students with no previous knowledge of the German language. Task-based teaching and other classroom activities, including individual group work and compulsory homework, will provide a variety of the basic techniques to use the main vocabulary and grammar of the language. At the end of the course they will be able to talk about themselves and their areas of study and ask others about personal details, work, hobbies, and interests. The students will be able to use simple sentences and expressions in daily life situations and will be able to interact in a simple way provided the other person talks slowly and is prepared to help (see also CEFR https://www.coe.int/en/web/common-european-framework-reference-languages/the-cefr-descriptors). Course material will be provided by the library, the lecturer and the Language Center.

**Professional Competence**

Students will demonstrate a good level of communication and empathy and will master interactions with other people. They will develop of an awareness of social and cultural conditions enabling them to act appropriately in complex situations- Students are able to apply strategies and methods for the formation and maintenance of networks in this area.

**Interdisciplinary Competence**

This course involves the integration of basic cultural, linguistic, geographical, and social studies to enhance learning. Students are introduced to German-speaking countries' customs, holidays, and traditional foods. They compare simple vocabulary and sentence structures between German and English or their native language. Geography lessons include identifying major German-speaking countries and cities on a map. Literature and music exposure involves reading stories and listening to German songs. Technology integration uses language learning apps and watching short German clips with subtitles (e.g. within Speexx). Role-playing helps practice everyday communication like greetings and ordering food. Social studies cover typical daily routines and school systems in Germany. Basic business etiquette includes learning formal greetings and simple business customs. This approach provides a well-rounded, contextual introduction to the German language and culture.

**Course Content** See description above.

**Literature** DaF Kompakt neu, Klett Verlag, Script

**Included Courses** (LV)

| LV-Nr. | Course Name | Lecturer | Type[21] | SWS | CP |
|---|---|---|---|---|---|
| 87202 | German as a Foreign Language 2 | Behzad Moini | Ü, S | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[22] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87202 | PLK (90 Minutes) | 100% - not graded | |

**Requirements for Admission to the Module Exam**

Participation in Practical Training, 70% of attendance

**Further Study-Related Feedback**

**Comments**

Mandatory module for international students at A1.2-level

**Last Update**: 15.07.2024, Miguel Vázquez, Head of Language Center

[21] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[22] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87006 SPO-Version: 34

## Technical English 2

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Miguel Vázquez, Head of Language Center |
| **Modul Type** | Mandatory Module for German students |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semesters |
| **Number LV** | Lecture |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 30 Hours |
| **Workload Self-Study** | 120 Hours |
| **Participation Requirements** | Formal: Passing the exam “Technical English 1”<br>Content: none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**General**

This course is designed to support the receptive and productive skills of technical language competencies across four skills: speaking, listening, reading and writing at the reference level B2.2 of the Common European Framework of Reference for Languages. Students will be better able to understand the main content of technical texts and discussions from different subject areas and to communicate spontaneously in interdisciplinary contexts.

A range of topics will provide the framework for the application of oral and written communicative competency.

Autonomous work outside the class as well as active in-class participation, interaction and feedback will be expected in class. To successfully complete the course, students will need to complete collaborative in-class assignments, submit coursework and give a presentation.

The course consists of two modules.

In Module 2 we will focus on the revision of grammar structures in a technical context. New vocabulary and expressions will be explained and applied. The vocabulary is presented in authentic texts and credible scenarios, ensuring maximal practicality for the students.

In the second semester students will have the opportunity to practice both written and oral communication skills.

Teaching materials related to the students' major fields of study form the framework for the development and application of further, often subject-specific language skills, (that) are required for effective language competence in the technical field.

In addition, more complex technical forms of written and oral communication are analyzed and actively produced.

**Professional Competence**

Professional competence (social skills und ability to work independently): Students must demonstrate a high level of communication and empathy in their professional life. Therefore, successful interactions with other people are practiced in a task-based training.

The development of an awareness of social and cultural conditions with the goal to act appropriately in complex situations constitute another important block in this lecture. Students will learn strategies and methods for the formation and maintenance of networks in this area.

**Interdisciplinary Competence**

In this technical English lecture, "Interdisciplinary Competence" integrates various fields and communication skills. Students learn essential technical vocabulary and grammar, focusing on terms used in engineering, IT, and science. They develop writing skills by creating simple technical descriptions and reports. Reading comprehension is enhanced through simplified technical articles and manuals. Listening skills are improved with short technical lectures and videos, emphasizing note-taking. Presentation skills are built through short technical presentations using visual aids. Practical communication is practiced via role-playing technical scenarios. Collaborative projects apply technical English in group settings. Real-world case studies are discussed to identify key issues and solutions. Cultural competence is developed by understanding international technical communication styles.

**Course Content** See description above.

**Literature** Script, text editing, reading comprehension, vocabulary and grammar, research tasks, and discussions. It includes analyzing texts like "The Real Jetsons - Personal Flight" (Inch - Technical English Inch by Inch, 13, 2/2017) and reading "A History of Electric Cars" by Nigel Burton (208 pages, The Crowood Press). Students will also engage in presentation preparation and delivery.

**Included Courses** (LV)

| LV-Nr. | Course Name | Lecturer | Type[23] | SWS | CP |
|---|---|---|---|---|---|
| 87203 | Technical English 2 | Doris Düwel | Ü, S | 2 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[24] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87203 | PLK (60 Minutes) | 50%, not graded | |
| 87203 | PLP | 50%, not graded | During the semester |

**Requirements for Admission to the Module Exam**

Participation in Practical Training, 70% of attendance

[23] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[24] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Further Study-Related Feedback**

**Comments**

Mandatory module for German students at B2.2-level

**Last Update**: 15.07.2024, Miguel Vázquez, Head of Language Center

## Module Number: 87007 SPO-Version: 34

## Computer Science 2

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Stefan Hörmann |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students will be able to explain and apply the basic concepts and special features of object-oriented programming. Selected applications of object-oriented programming such as graphical user interfaces and the processing of office documents can be used for the realization of practical projects.

**Interdisciplinary Competence**

The students are able to solve tasks together and work as a team. In addition, by working on a project, students are able to form project teams, analyze tasks, carry out the project and present the results in a presentation.

**Course Content** The module introduces the basics of object-oriented programming. The following topics are covered:

Classes and instances
Definition of methods
Special methods, such as constructor, destructor, ...
Creating attributes
Inheritance
Overriding methods
Multiple inheritance
Setter and getter methods (property attributes)
Class attributes and class methods
Overloading operators
Built-in functions for object orientation
Modularization
Selected applications of object-oriented programming:
Graphical user interfaces
Processing office documents

The topics introduced are tested and consolidated in practice by working on programming exercises and a project.

**Literature**

M. Lutz, *Programming Python*, O'Reilly Media
L. Ramalho, *Fluent Python*, O'Reilly Media
E. Matthes, *Python Crash Course*, No Starch Press

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[25] | SWS | CP |
|---|---|---|---|---|---|
| 87204 | Computer Science 2 | Prof. Dr. Stefan Hörmann | V,Ü | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[26] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87204 | PLK (60 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

Successful participation in the programming exercises

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Stefan Hörmann

[25] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[26] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 88005 SPO-Version: 34

## Physics

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Axel Löffler |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 2. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 90 Hours |
| **Workload Self-Study** | 60 Hours |
| **Participation Requirements** | Formal: *none*<br>Content: *none* |
| **Use in other SG** | Mechanical Engineering |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

***Know That***

The students are able to **understand** and correctly **apply** the **scientific vocabulary** in a given physical context. In addition, they are able to **quote** the **definitions** of the scientific terms.

Students know basic physical quantities and units and can work confidently with physical formulas and equations.

***Know Why***

The students are able to **provide examples** concerning the **definitions** of scientific terms and the application of specific **methods**. Moreover, they are able to **explain why** the application of a specific method to a given problem is **effective**.

***Know How***

The students are able to **analyse** given problems, to **select** and **apply appropriate methods** to solve the given problems, thereby **adapting** the standard solution processes to problem specific needs. The students can plan, execute and evaluate experiments. Furthermore, they can estimate the effect of measurement uncertainties on the final result of the experiments.

**Interdisciplinary Competence**

The students are able to **self-organize their learning process**, including weekly **repetition of** and **reflection on** the course material, doing **additional exercises**, deepening their knowledge by **literature study** and **preparing questions** to the lecturer. Ideally, this takes place **in teamwork** with their co-students.

Course Content

***Physical Quantities and Units of Measurement***

Definitions of scientific terms: observables, measurements, SI units (metrical system)

Physical quantities: measure numbers and units, comparison of physical quantities, multiplication and addition of physical quantities, unit conversion, basic physical quantities in the context of mechanics, treatment of uncertainties in measurements,

how to solve a basic physical problem

The process of scientific reasoning will be trained using basic models and test cases from the following disciplines:

***Kinematics and Dynamics of Translational Movements from the perspective of physics***

Definitions of scientific terms: kinematic quantities (location, velocity, acceleration), mass, force, energy, work, power, momentum

Principles of classic mechanics: Newton's axioms, equations of motion, friction, examples (freefall, superimposed movements, inclined plane, impact movement, etc.), inertial forces

***Kinematics and Dynamics of Rotational Movements from the perspective of physics***

Definitions of scientific terms: kinematic quantities (angle, angular velocity, angular acceleration), moment of inertia, torque, energy, work, power, angular momentum

Principles of classic mechanics: Newton's axioms, equations of motion, friction, examples (hammer throw, turntable, rolling motion, etc.), inertial forces

***Kinematics and Dynamics of Mechanical Oscillations from the perspective of physics***

Definitions of scientific terms: (harmonic) oscillation, restoring force/momentum, frequency and circular frequency, period duration

Basic examples (spring pendulum, thread pendulum), damped oscillations, externally driven oscillations, superimposed oscillations

***Physics Laboratory***

Planning, execution and evaluation of physical experiments; estimation and evaluation of measurement uncertainties; the competences are trained doing two experiments: M1 (Maxwell's wheel – rolling movement) and S1 (mechanical oscillations)

Literature

R. A. Serway, J. W. Jewett: *Physics for Scientists and Engineers with Modern Physics*, Brooks Cole Publishers, 2018

D. C. Giancoli: *Physics for Scientists & Engineers with Modern Physics*, Global Edition, Pearson, 2023

R. Shankar: *Fundamentals of Physics I: Mechanics, Relativity, and Thermodynamics*, Expanded Edition, Open Yale Courses, 2019

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[27] | SWS | CP |
|---|---|---|---|---|---|
| 88203 | Physics | Prof. Dr. Axel Löffler | V, Ü, L | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[28] | Determination of Module Grades | Comments |
|---|---|---|---|
| 88203 | **PLK** – written exam (90 minutes) | 100% | **40** of 90 points: passed (4.0)<br>**80** of 90 points: excellent (1.0) |

**Requirements for Admission to the Module Exam**

The students have to be **present at 75%** of the given courses up to the last date of signing off for the exam.
In addition, they have to **complete** the following **6 MatlabAcademy** self-paced **online courses**:

Matlab Onramp, Simulink Onramp, Statistics Onramp, Optimization Onramp, Introduction to Symbolic Math (with Matlab), Introduction to Linear Algebra (with Matlab).

Finally, the students have to **carry out two laboratory experiments** at the central physics laboratory (experiments M1 and S1). The **laboratory reports** for each off the two experiments have to be graded as "**passed**".

**Further Study-Related Feedback**

**Feedback** on questions and answers both from the students and the lecturer.

**Comments**

The exam takes place as an **online-written exam** using **DigiExam** and **MatlabGrader**. The exam is **graded automatically**. The students may **run** their scripts **as often as they like** and **submit** them **5 times**.
Points are only awarded for correct assignments of variables. In particular, no points are awarded if there are any syntactical errors in the script.

**Last Update**: 25.06.2024, Prof. Dr. Axel Löffler

[27] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[28] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87020 SPO-Version: 34

## Advanced Topics in Mathematics

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Holger Schmidt |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 3. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | Mathematics 1 and 2, System Dynamics |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students are able to apply the Integral Transforms (Fourier- and Laplace), the Discrete Fourier Transform and Statistics to engineering problems. They are able to apply modern toolboxes of mathematical methods needed in subsequent lectures and in modern industry.

**Interdisciplinary Competence**

Students are able to work together in a team, communicate with each other in a solution-oriented manner and support each other.

**Course Content**

- Fourier Transform,
- Discrete Fourier Transform (DFT/FFT)
- Discrete Time Fourier Transform (DTFT)
- Laplace Transform and z-Transform
- Basics of Signal Processing
- Continuous Time and Discrete Time Linear Time Invariant (LTI) Systems
- Radon Transform/Computertomography
- Introduction to Statistics (Random Variables, Probabilty Distributions)

**Literature**

Lecture Notes and Jupyter-Notebooks
Shima, Nakayama, Higher Mathematics for Physics and Engineering, Springer
Brad Osgood, The Fourier Transform and its Applications,
https://see.stanford.edu/materials/lsoftaee261/book-fall-07.pdf

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[29] | SWS | CP |
|---|---|---|---|---|---|
| 87601 | Advanced Topics in Mathematics | Prof. Dr. Holger Schmidt | V,Ü | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[30] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87601 | PLK (120 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**
Successful participation in the exercises

**Further Study-Related Feedback**

**Comments**

**Last Update**: 11.07.2024, Prof. Dr. Holger Schmidt

[29] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[30] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87008 SPO-Version: 34

## Electrical Drive Technology

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Arif Kazi |
| **Modul Type** | Mandatory |
| **Academic Semester** | 3. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Term |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students are able to describe the structure and behavior of typical electrical drives for mechatronic systems. They are able to interpret the most important parameters of the drives covered. They are also able to model and analyze the dynamic behavior of mechatronic drive systems as a mechatronic network. Students master the basics of Matlab/Simulink and are able to apply the basic programming commands.

**Interdisciplinary Competence**

In the practice phases, students are able to work as a team and to discuss and solve technical problems together.

**Course Content**

Fundamentals of magnetic fields
Electrodynamic actuators
Reluctance actuators
DC motors
Actuators based on "smart" materials

**Literature**

Kazi, A.: *Electrical Drive Technology.* Lecture notes for the course
Jiles, D.: *Introduction to Magnetism and Magnetic Materials* (3rd ed.). CRC Press (2015)
Rao, A.; Srinivasa, A.R.; Reddy, J.N.: *Design of Shape Memory Alloy (SMA) Actuators*. Springer (2015)

Further literature:
Kallenbach, E.; Stölting, H.D.; Amrhein, W.: *Handbook of Fractional-Horsepower Drives.* Springer (2008)
Hughes, A., Drury, B.: *Electric Motors and Drives: Fundamentals, Types and Applications* (5th ed.). Newnes/Elsevier (2019)

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[31] | SWS | CP |
|---|---|---|---|---|---|
| 87301 | Electrical Drive Technology | Prof. Dr. Arif Kazi | V,Ü,P | 5 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[32] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87301 | PLK (90 Minutes), PLP | 80%, 20% | |

**Requirements for Admission to the Module Exam**
Successful participation in the joint project for the courses "Electrical Drive Technology" and "Power Electronics"

**Further Study-Related Feedback**

**Comments**

**Last Update**: 23.06.2024, Prof. Dr. Arif Kazi

[31] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[32] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87009 SPO-Version: 34

## Power electronics

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Markus Glaser |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 3. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students will be able to select and dimension power electronic circuits with regard to their properties and function. In particular, students will be able to describe different control methods and the effects on other system components. Students will be able to dimension components for the most common power electronics circuits, determine the material costs of a device and design the most common power electronics circuits. They will be able to analyze the static and dynamic behavior of common power semiconductors. Students will also be able to design heat sinks for heat dissipation and describe the most important mains and self-controlled circuits and the control process as well as simulate the circuits. Furthermore, students will be able to describe the most important basic circuits for converters and thus the possible applications in energy technology as well as the feedback effects on the supplying network.

In the project part, students are able to independently apply the content of the lecture to a practical task. They master the basics of Matlab/Simulink and are able to apply the basic programming commands. On this basis, they create a simulation model of the actuator and control electronics and design the necessary components.

**Interdisciplinary Competence**

Students are able to proceed methodically when solving problems. Students are able to apply and document their skills and abilities independently, individually or in a team, to a specific task and to present and discuss the results.

**Course Content**

1. introduction to power electronics
Fundamentals
Electrical variables in switching operation
Power balance
Operating quadrants

2. power semiconductors
Comparison of ideal / real switches
Diodes
Transistors
Protection of power semiconductors
Cooling of power semiconductors

3. rectifier circuits
Bridge circuit of line-commutated rectifiers (B2 / B6)
Reactive power in rectifiers
Power factor correction

4. direct current controller
Buck converter
Step-up converter
Multi-quadrant converter
Full bridge
Control for MOS transistors

5. DC-AC converters
Single-phase converters
Three-phase converters
Areas of use and applications

**Literature**

Recommendation: 3 to 5 references to basic literature;
explicitly mark further literature

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[33] | SWS | CP |
|---|---|---|---|---|---|
| 87302 | Power Electronics | Prof. Dr. Markus Glaser | V,Ü,P | 5 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[34] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87302 | PLK (90 Minutes), PLP | 80%, 20% | |

[33] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[34] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Requirements for Admission to the Module Exam**
Successful participation in the joint project for the courses "Drive Technology" and "Power Electronics"

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Markus Glaser

## Module Number: 87010 SPO-Version: 34

## Sensors and Data Acquisition

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Arif Kazi |
| **Modul Type** | Mandatory |
| **Academic Semester** | 3. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Term |
| **Credits** | 5 CP |
| **Workload Class** | 75 Hours |
| **Workload Self-Study** | 75 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students are able to explain selected physical sensor principles with sensor technology and electronics. They can describe the basic structure of the respective sensor. They will be able to name the metrological properties of sensors and assess their advantages and disadvantages for the respective application. They will be able to select and use suitable sensors for the respective problem.

**Interdisciplinary Competence**

In the laboratory exercises in small groups, students are able to carry out tasks together and work as a team.

**Course Content**

Metrological properties of sensors
Basics of measurement data acquisition
Sensors Calibration
Potentiometric sensors
Strain gage sensors
Piezoresistive sensors
Galvanomagnetic sensors
Inductive sensors
Eddy current sensors
Capacitive sensors
Measurement amplifiers

**Literature**

Kazi, A.: *Sensors and Data Acquisition.* Lecture notes for the course

Fraden, J.: *Handbook of Modern Sensors: Physics, Designs, and Applications* (5th ed.). Springer (2016)

Czichos, H.: *Measurement, Testing and Sensor Technology.* Springer (2018)

Further literature:

Wilson, J.S.: *Sensor Technology Handbook.* Newnes/Elsevier (2004)

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[35] | SWS | CP |
|---|---|---|---|---|---|
| 87303 | Sensors and Data Aquisition | Prof. Dr. Arif Kazi | V,Ü | 5 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[36] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87303 | PLM (30 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 24.07.2024, Prof. Dr. Arif Kazi

[35] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

[36] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87011 SPO-Version: 34

## Digital Technology

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Jürgen Baur |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 3. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students can implement logical links with HW and SW for mechatronic control systems. They can explain the structure and functionality of electronic microcontroller control units and can implement simple algorithms at machine level, e.g. for controlling peripherals.

**Interdisciplinary Competence**

In the laboratory exercises in small groups, students are able to carry out tasks together and work as a team.

**Course Content**

Basic logic operations and circuit symbols in digital technology, Boolean algebra
TTL/CMOS family, logic circuits and flip-flops
Introduction to microprocessor technology
Structure and function of microcontroller control units
Structure and function of a control unit
Memory architecture and peripheral modules
Machine programming of the 80C51 family
Assembler programming A51 of the 80C51 family

**Literature**

D. Harris and S. Harris, *Digital Design and Computer Architecture*, MK
D. Patterson and J. Hennessy, *Computer Organization and Design*, MK
E. Hwang, *Digital Logic and Microprozessor Design*, CL Engineering

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[37] | SWS | CP |
|---|---|---|---|---|---|
| 87304 | Digital Technology | Prof. Dr. Jürgen Baur | V,Ü | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[38] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87304 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**
Successful participation in the exercises.

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Jürgen Baur

[37] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[38] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87012 SPO-Version: 34

## Embedded Control Systems

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Jürgen Baur |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 3. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students are able to program embedded control units in C as well as model-based control units ECU's with autocode generation. Students are able to simulate and debug state machines. Students can create a model-based software design with the help of Matlab-Stateflow. They can practically implement and test control algorithms on real ECUs, as well as measurement technology on microcontroller platforms Atmel T89C51CC01 and Raspberry Pi.

**Interdisciplinary Competence**

Through the laboratory exercises in teams and small groups, students are able to solve tasks together and act as a team.

**Course Content**

Control algorithms in ANSI C
State machines in ANSI C
Interrupt processing
Counting events (counter programming)
Counting times (timer programming)
Debugging with the Keil IDE uVision5 development system
Model-based development process MBSE
Implementation of finite state machines in UML with Matlab-Stateflow
Automatic code generation with Matlab Embedded Coder
Code integration in software project
Development of basic software for the control unit
Verification of the functions on the control unit with Test-Bench

**Literature**

J. Valvano, *Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers*, CreateSpace Independent Publishing Platform

R. Barnett, S. Cox and L. O'Cull, *Embedded C Programming and the Atmel AVR*, Cengage Learning

M. Trincavelli, *Model-Based Development: Applications*, Springer

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[39] | SWS | CP |
|---|---|---|---|---|---|
| 87305 | Embedded Control Systems | Prof. Dr. Jürgen Baur | V,Ü,L | 5 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[40] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87305 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Jürgen Baur

[39] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[40] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87014 SPO-Version: 34

## System Dynamics

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Bernhard Höfig |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 4. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students can apply the basic methods for describing linear dynamic systems in the time and frequency domain. They are able to determine elementary problems for the description of the dynamic behavior of technical systems. They can calculate and represent the basic properties of these systems. The basics of programming in Matlab can be applied. Students will be able to create their own functions and programs to solve simple problems in the field of system dynamics.

The students will be able to apply the mathematical principles for describing time-varying variables to typical areas of mechatronics. They will be able to characterize the properties of linear, time-invariant systems and describe basic methods for modelling. Students will be able to use the methods for physical modeling with the help of mechatronic networks.

**Interdisciplinary Competence**

The students are able to apply the knowledge, skills and abilities they have acquired during their studies independently and in a team to a specific task, to develop solutions, to document the work steps in a comprehensible manner and to present and discuss the results.

**Course Content**

1. Signals and systems
Basic concepts of systems theory
Standard signals
Input-output description of linear systems
Step and impulse response

2. Introduction to modeling technical systems
Physical modeling
Mechatronic networks

3. Methods for analyzing systems in the time and frequency domain
LTI systems
Fourier Transform
Frequency response, Bode and Nyquist diagrams
Laplace Transform

4. Basics of Matlab/Simulink
Introduction and basics of the Matlab development environment
Programming with Matlab script
Troubleshooting in Matlab programs
First steps with Simulink

**Literature**

A. V. Oppenheim, A. S. Willsky und S. H. Nawab, *Signals and Systems*. Harlow, Essex: Pearson Education, 2014
K. Ogata, *System Dynamics,* 4. Aufl. Harlow: Pearson, 2014
N. S. Nise, *Control Systems Engineering*. Hoboken, NJ: Wiley, 2019
Matlab/Simulink Tutorial (https://de.mathworks.com/support/learn-with-matlab-tutorials.html , abgerufen am 20.06.24)

Further Literature
K. A. Stroud, *Advanced Engineering Mathematics,* 6. Aufl. London: Macmillan Education UK, 2020.
R. C. Dorf und R. H. Bishop, *Modern Control Systems*. Harlow: Pearson, 2022

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[41] | SWS | CP |
|---|---|---|---|---|---|
| 87401 | System Dynamics | Prof. Dr. Bernhard Höfig | V,Ü | 4 | 5 |

[41] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[42] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87401 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 20.06.2024, Prof. Dr. Bernhard Höfig

[42] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87015 SPO-Version: 34

## Product Design

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Bernhard Höfig |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 4. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students are able to describe and work on individual phases of the product life cycle from the idea to disposal as well as the resulting documents. Students will be able to explain the development and design process and create the associated production documents.

Students are able to analyze the development task and then find a solution to a technical problem systematically, using various methods for design and project management . Students will be able to describe the basics of machine safety and conformity assessment.

**Interdisciplinary Competence**

The students are able to communicate in a subject-specific manner and act in a team-oriented manner. Students can assume responsibility in a team.

**Course Content**

Systematic design
Product development process
Project planning and task clarification
Selection of methods
Conceptualizing, drafting, designing, elaborating
Development methodology for mechatronic systems
Agile product development methods

**Literature**

Vajna S., Hg.: Integrated Design Engineering: Interdisciplinary and Holistic Product Development, 1. Aufl. Cham: Springer International Publishing; Imprint Springer, 2020.

Pahl G., Beitz W., Feldhusen J., Grote K.H.: Engineering Design – A systematic Approach, Third Edition, Springer Verlag London Limited, 2007

K. T. Ulrich und S. D. Eppinger, Product Design and Development. New York, NY: McGraw-Hill Education, 2019.

VDI 2221: Design of Technical Products and Systems – Model of product design

VDI/VDE 2206: Development of Mechatronic and Cyber-Physical Systems

Further Literature:

K.-H. Grote und H. Hefazi, Hg.: Springer Handbook of Mechanical Engineering, 2. Aufl. Cham: Springer, 2021.

S. Keivanpour: Circular Economy in Engineering Design and Production: Concepts, Methods, and Applications, 1. Aufl. Cham: Springer International Publishing; Imprint Springer, 2024.

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[43] | SWS | CP |
|---|---|---|---|---|---|
| 87402 | Product Design | Prof. Dr. Bernhard Höfig | V,Ü,P | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[44] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87402 | PLP, PLM | 80%, 20% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 20.06.2024, Prof. Dr. Bernhard Höfig

[43] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[44] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87016 SPO-Version: 34

## Mechanical Design

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Peter Eichinger |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 4. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students are able to apply the basics of "technical drawing" and the basics of design theory. Students can describe and depict the function and geometry of construction elements of simple constructions. Students are able to apply the rules for technical drawing and thus create a standard-compliant technical drawing (freehand drawings). Students will be able to represent individual parts in a technical drawing and correctly specify surface roughness, hardness specifications and shape and position tolerances. Students are able to obtain information for the preparation of their designs for the given tasks (library, standards catalog, internet research). They are able to combine design elements to create simple constructions. They can represent selected design elements in accordance with standards.

**Interdisciplinary Competence**

Through the exercises, students are able to work together as a team and support each other to solve the tasks set.

**Course Content**

Design systems, CAD, execution rules, drawing fundamentals, representation methods, dimensions, surfaces, edges and corrosion protection, tolerances and fits, screw connections. Practicing the rules learned for technical drawing.

Function of components (plain bearings, roller bearings, guides, air bearings, hydrostatic bearings and guides, spring bearings, screw guides).

**Literature**

GD&T, Second Edition, Springer 2024

Giesecke, F.E, Mitchell, A., Spencer, H.C., Hill, I.L., Dygodon, J.T: Technical Drawing, 8, Edition

R. Mott, E. Vavrek, J. Wang, Machine Elements in Mechanical Design, 6th edition. München: Pear-son, 2017

Pahl, G. and Wallace, K.: Engineering Design - A Systematic Approach, 3rd ed., London: Springer, 2007

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[45] | SWS | CP |
|---|---|---|---|---|---|
| 87403 | Mechanical Design | Prof. Dr. Peter Eichinger | V,Ü,P | 4 | 3 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[46] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87403 | PLK (60 Minutes), PLE | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 02.07.2024, Prof. Dr. Peter Eichinger

[45] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[46] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87017 SPO-Version: 34

## Manufacturing Technology

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Fabian Holzwarth |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 4. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students can apply the most important industrial manufacturing processes. They can establish the connection to manufactured components and assemblies. They will be able to name the manufacturing processes used in selected designs and design them appropriately. They will be able to select the tolerancing of simple designs to suit the function and the manufacturing process used and will be able to use the most important measurement methods for the product properties.

**Interdisciplinary Competence**

Students are able to apply their skills to specific tasks both independently and as part of a team.

**Course Content**

Mechatronic manufacturing processes:

Primary forming, generative processes, moulding, cutting, joining, coating, changing material properties. Other processes: Electronics manufacturing. Achievable tolerances, economic aspects. Design guidelines, especially for injection molding and additive manufacturing (3D printing).

Production metrology basics:

Measurement deviations, measurement uncertainty, selected measurement methods for geometric dimensions and material properties, tolerancing of geometries according to ISO-GPS.

**Literature**

M.P. Groover, *Modern Manufacturing: Materials Processes and Systems*, Wiley

S. Kalpakjan and S. R. Schmid, *Manufacturing Engineering and Technology*, Pearson

S. Kalpakjan and S. R. Schmid*, Manufacturing Processes for Engineering Materials,* Pearson

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[47] | SWS | CP |
|---|---|---|---|---|---|
| 87404 | Manufacturing Technology | Prof. Dr. Fabian Holzwarth | V,Ü,P | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[48] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87404 | PLK (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Fabian Holzwarth

[47] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[48] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87018 SPO-Version: 34

## Networks and Distributed Systems

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Stefan Hörmann |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 4. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students are able to develop microcontroller-controlled sensor and actuator modules using the bus systems presented. Students will be able to use these sensor and actuator modules to develop heterogeneous, distributed systems with the help of the introduced middleware and analyze them using the introduced measuring equipment.

**Interdisciplinary Competence**

Through the laboratory exercises in teams and small groups, students are able to solve tasks together and act as a team.

**Course Content**

Communication: ISO/OSI reference model, media access, Manchester coding, asynchronous data transmission: RS-232 and RS-485, Synchronous data transmission: I2C and SPI, fieldbus systems: CAN bus, TCP/IP protocol stack, addressing, synchronization, serialization.

A selection of the most important principles of distributed systems is dealt with using ROS2: Definition of data packets with ROS IDL, unicast and multicast data streams with ROS Topics, remote procedure calls with ROS Services. Building heterogeneous, distributed systems with µROS

**Literature**

A. Tanenbaum and D. Wetherall, *Computer Networks*, Pearson

W. Stallings, *Data and Computer Communications*, Pearson

A. Koubaa, *Robot Operating System (ROS): The Complete Reference*, Springer

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[49] | SWS | CP |
|---|---|---|---|---|---|
| 87405 | Networks and Distributed Systems | Prof. Dr. Stefan Hörmann | V,Ü, | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[50] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87405 | *P*LK (90 Minutes), PLL | 50%, 50% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Stefan Hörmann

[49] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[50] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 88014 SPO-Version: 34

## Process Automation and Control

| | |
|---|---|
| **Degree Program** | Mechanical Engineering – Bachelor of Engineering (B.Eng.) |
| **Module Manager** | Prof. Dr. Tilman Traub |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 4. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 2 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 75 Hours |
| **Workload Self-Study** | 75 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | |
| **Language** | English |

**Module Objectives**

**General**

Students are able to describe the basic structure of representative automation systems and can explain the basic application of sensors and actuators in this area. They can differentiate the different levels of the automation pyramid and can describe the structure, functions and limits of the individual levels.

Students can propose a concept for an information flow in open-loop control systems. They can apply the knowledge and methods to simple applications and derive the functional equations for automation tasks.

Students are able to apply the basic fundamentals of closed-loop control systems and can describe close loop control systems in time and frequency range. They are able to set the parameters of PID-controllers and estimate the behavior and remaining control deviation of the system based on the settings chosen.

**Interdisciplinary Competence**

Students are able to apply the methods and knowledge they have learned to current issues in small teams. As a result, they have the competence to engage in argumentative debate in the subject area and are thus able to act independently.

**Course Content**

- Basic structure of automation systems
- Basics and characteristics of open-loop control systems
- Methods for designing open-loop control systems and application
- Basics and characteristics of closed-loop control systems
- Methods for designing closed-loop control systems and application

**Literature**

Course script

Additional references for further studies:

Kls Sharma: Overview of industrial process automation. Elsevier, 2017

Stamatios Maneis, George Nikolakopoulos: Introduction to Industrial Automation. CRC Press, 2018

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[51] | SWS | CP |
|---|---|---|---|---|---|
| 88405 | Process Automation and Control | Prof. Dr. Tilman Traub | V | 4 | 5 |
| 88406 | Process Automation and Control – Lab | Prof. Dr. Tilman Traub | L | 1 | |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[52] | Determination of Module Grades | Comments |
|---|---|---|---|
| 88405 | PLK (60 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

Successful participation of process automation and control – lab.

**Further Study-Related Feedback**

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**Comments**

none

**Last Update**: 11.07.2024, Prof. Dr. Tilman Traub

[51] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[52] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87555 SPO-Version: 34

## Placement Semester/Internship

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Head of the Internship Office (Praktikantenamtsleiter) |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 5. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 30 CP |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

**Module Objectives**

The students are able to apply the knowledge and methods they have assess and apply the knowledge and methods they have acquired during their studies.

**Professional Competence**

Students can apply the knowledge and methods they have acquired to date within the real world of work. Students are also able to describe the course of projects in industry. They specialist their knowledge in projects and strengthen their social skills. Through the writing the technical report, students are able to reflect on and document the approach of their reflect on and document their technical work. Students can apply activity-specific methods within the industry and proceed systematically when in the development of a solution.

**Interdisciplinary Competence**

Students are able to integrate themselves into an existing team within the company integrate into an existing team in the company. The students are also able to discuss and evaluate their professional activities, activities they have carried out during the practical semester and to present these in a colloquium.

**Course Content**

Work in industry or research center

**Literature**

-

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[53] | SWS | CP |
|---|---|---|---|---|---|
| 87555 | | | | | |

[53] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

**Module Examination**

| LV-Nr. | Type and Duration of Proof of Performance[54] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87555 | | | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 20.06.2024, Prof. Dr. Holger Schmidt

[54] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87019 SPO-Version: 34

## Human-Robot Interaction

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr.-Ing. Markus Glück |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students are able to describe new forms of human-machine -interaction and in particular with human-robot-interaction using applied robotics in automated assembly and vision-based robots as key examples. They will be able to design and evaluate new forms of human-robot interaction and implement them in operational and non-operational environments.

Students will be able to transfer new forms of human-robot-interaction into practical applications based on their knowledge of relevant safety regulations and concurrent normative directions. They will be able to describe the current legal framework for human-centerd workplace dsign. Consequently, they will be able to describe working environments and the resulting requirements for the realization and introduction of fenceless human-robot interaction in different application fields. They will be able to explain future concepts and technology trends for the intuitive and intelligent design of human-robot interaction and in particular the possible contribution from using latest AI technologies and methods.

**Interdisciplinary Competence**

The students will be able to apply the knowledge, skills and abilities they have acquired independently and in a team to a specific task, develop innovative solutions, document the work steps in a comprehensive manner, present and discuss the results. They are also able to evaluate the trending topic of "human-centered robotics and automation" and related ethical aspects and help shape its social framework.

**Course Content**
Introduction to human-robot and human-machine interaction
Simulation and control of cobots
Perception and cognition, HMI design and new forms of interaction
Intuitive forms of robot operation, visualization and training, workplace design for human-robot interaction, digital twins
Robots, end effectors and sensor systems for human-robot interaction
Safety, standards and legal framework for human-robot interaction
Workspace monitoring and end effector design for human-robot interaction
Mobile interaction, exoskeletons and handling assistants
Human-robot interaction in medicine, care and service
Ethical aspects of human-robot interaction in the economy and society

**Literature**
Peter Corke, *Robotics, Vision and Control*, 2nd Edition, Springer, 2013
Bruno Sciliano, Oussama Khatib (Eds.), *Springer Handbook of Robotics*, 2nd Edition, Springer, 2016
Céline Jost, Brigitte Le Pévédic, Tony Belpaeme, Cindy Bethel, Dimitrios Chrysostomou, Nigel Crook, Marine Grandgeorge, Nicole Mirnig, *Human-Robot Interaction: Evaluation Methods and Their Standardization*, 1st Edition, Springer, 2020
Christoph Bartneck, Tony Belpaeme, Friederike Eyssel, Takayuki Kanda, Merel Keijsers, Selma Šabanović, *Human-Robot Interaction: An Introduction*, Cambridge University Press, 2020
Markus Glück, *Mensch-Roboter-Kooperation erfolgreich einführen*, 1st Edition, Springer, 2022
Hans-Jürgen Buxbaum (Ed.), *Mensch-Roboter-Kollaboration*, 1st Edition, Springer, 2020

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[55] | SWS | CP |
|---|---|---|---|---|---|
| 87406 | Human-Robot Interaction | Prof. Dr. Markus Glück | V,Ü,L | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[56] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87406 | PLK (60 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**
Successful participation in laboratory exercises

**Further Study-Related Feedback**

**Comments**

**Last Update**: 20.06.2024, Prof. Dr. Markus Glück

[55] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[56] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87021 SPO-Version: 34

## Mechatronics Project

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Dean of Studies |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 0 Hours |
| **Workload Self-Study** | 150 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students will be able to analyze a mechatronic problem, find and implement solutions and present the results. They can carry out an application-oriented project and contribute to solving complex tasks as part of a team.

Students are able to plan, coordinate, implement and solve a complex project independently, applying the content, methods and specialist knowledge they have learned so far and gaining further specialist knowledge within the respective task through their own experience. During excursions, students gain insights into project work in different companies. They are able to transfer these learnings to their own project work.

**Interdisciplinary Competence**

The students are able to plan a project systematically in terms of time and apply suitable methods and systematic working principles to find solutions. Through group work, students are able to organize and divide up work independently and coordinate within the team.

Students are able to present and defend their results in front of an audience. They can justify the approach to their work and the results achieved with theoretical and methodological knowledge and assess their own abilities. The skills acquired serve as the basis for a professional self-image for professional action.

**Course Content** Project

**Literature** Depending on the project

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[57] | SWS | CP |
|---|---|---|---|---|---|
| 87602 | Mechatronics Project | Prof. Dr. Holger Schmidt | P | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[58] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87602 | PLP | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 11.07.2024, Prof. Dr. Holger Schmidt

[57] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[58] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87022 SPO-Version: 34

## Elective Module

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | NN |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English or German |

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**Module Objectives**

**Professional Competence**
Depending on the module selected

**Interdisciplinary Competence**
Depending on the module selected

**Course Content**

**Literature** Depending on the module selected

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[59] | SWS | CP |
|---|---|---|---|---|---|
| 87603 | Depending on the module selected | | | | |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[60] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87603 | Depending on the module selected | | |

[59] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[60] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Requirements for Admission to the Module Exam**

Depending on the module selected

**Comments**

none

**Last Update**: TT.MM.JJJJ, Prof. Dr.

## Module Number: 87023 SPO-Version: 34

## Elective Module

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | NN |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English or German |

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**Module Objectives**

**Professional Competence**
Depending on the module selected

**Interdisciplinary Competence**
Depending on the module selected

**Course Content**

**Literature** Depending on the module selected

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[61] | SWS | CP |
|---|---|---|---|---|---|
| 87604 | Depending on the module selected | | | | |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[62] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87604 | Depending on the module selected | | |

[61] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[62] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Requirements for Admission to the Module Exam**

Depending on the module selected

**Comments**

none

**Last Update**: TT.MM.JJJJ, Prof. Dr.

## Module Number: 87024 SPO-Version: 34

## Elective Module

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | NN |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English or German |

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**Module Objectives**

**Professional Competence**
Depending on the module selected

**Interdisciplinary Competence**
Depending on the module selected

**Course Content**

**Literature** Depending on the module selected

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[63] | SWS | CP |
|---|---|---|---|---|---|
| 87605 | Depending on the module selected | | | | |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[64] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87605 | Depending on the module selected | | |

[63] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[64] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Requirements for Admission to the Module Exam**

Depending on the module selected

**Comments**

none

**Last Update**: TT.MM.JJJJ, Prof. Dr.

## Module Number: 87025 SPO-Version: 34

## Elective Module

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | NN |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English or German |

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**Module Objectives**

**Professional Competence**
Depending on the module selected

**Interdisciplinary Competence**
Depending on the module selected

**Course Content**

**Literature** Depending on the module selected

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[65] | SWS | CP |
|---|---|---|---|---|---|
| 87606 | Depending on the module selected | | | | |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[66] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87606 | Depending on the module selected | | |

[65] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[66] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

**Requirements for Admission to the Module Exam**

Depending on the module selected

**Comments**

none

**Last Update**: TT.MM.JJJJ, Prof. Dr.

## Module Number: 87026 SPO-Version: 34

## Machine and Deep Learning

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Holger Schmidt |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 7. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

The students are able to describe the machine learning landscape and its fundamental concepts. They can apply modern machine learning toolboxes (like keras, tensorflow), used in modern industry, to analyse and solve machine learning tasks. German students may improve their skills in technical English.

**Interdisciplinary Competence**

Students are able to work together in a team and communicate with each other in a solution-oriented manner.

**Course Content**

Introduction Python/Keras/Tensorflow

The Machine Learning Landscape, Supervised and Unsupervised Learning

Supervised Learning: Regression and Classification, Neural Networks (NN) and Convolutional Neural Networks (CNN), Decision Trees/ Random Forests

Unsupervised Learning: Principal Component Analysis, K-Means Clustering/ Gaussian Mixture Models, (Deep) Autoencoder

Introduction to Reinforment Learning

**Literature**

Lecture Notes and Jupyter Notebooks
A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow*, O'Reilly
I. Goodfellow et al., *Deep Learning*, MIT Press, https://www.deeplearningbook.org/
A. Ng, *CS229: Machine Learning*, Stanford University, YouTube-Playliste

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[67] | SWS | CP |
|---|---|---|---|---|---|
| 87701 | Machine and Deep Learning | Prof. Dr. Holger Schmidt | V,Ü | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[68] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87701 | PLK (120 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Holger Schmidt

[67] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[68] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87027 SPO-Version: 34

## Control Engineering

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Prof. Dr. Jürgen Baur |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 7. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English |

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**Module Objectives**

**Professional Competence**

Students can design and set up dynamic control systems. They are able to apply basic synthesis methods in the time and frequency domain of control systems. They are also able to interpret the controller behavior. They will be able to use the most important continuous-time controller structures (PID control, cascade control) and their design principles. Students can model control systems in Matlab Simulink as a signal flow diagram and carry out controller synthesis through simulation.

**Interdisciplinary Competence**

Through the integrated exercises, students are able to communicate about the content.

**Course Content**

Modelling of mechatronic systems (SISO transmission elements, signal flow diagram, linearization)
Continuous-time and discrete-time control systems
Single-loop PID control systems
Frequency characteristic methods
Magnitude and symmetrical optimum, aperiodic damping
Cascade control systems
Feedforward control and dynamic compensation
Set-point filtering
Controller synthesis with MATLAB PID tuner app

**Literature**

N. Nise, *Control Systems Engineering*, Wiley
K. Ogata, *Modern Control Engineering*, Pearson
R. Dorf and H. Bishop, *Modern Control Systems*, Pearson

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[69] | SWS | CP |
|---|---|---|---|---|---|
| 87702 | Control Engineering | Prof. Dr. Jürgen Baur | V,Ü,L | 4 | 5 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[70] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87702 | *PL*K (90 Minutes) | 100% | |

**Requirements for Admission to the Module Exam**

**Further Study-Related Feedback**

**Comments**

**Last Update**: 15.06.2024, Prof. Dr. Jürgen Baur

[69] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[70] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

## Module Number: 87028 SPO-Version: 34

## Elective Module

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | NN |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 6. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Summer Semester |
| **Credits** | 5 CP |
| **Workload Class** | 60 Hours |
| **Workload Self-Study** | 90 Hours |
| **Participation Requirements** | none |
| **Use in other SG** | - |
| **Language** | English or German |

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**Module Objectives**

**Professional Competence**
Depending on the module selected

**Interdisciplinary Competence**
Depending on the module selected

**Course Content**

**Literature** Depending on the module selected

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[71] | SWS | CP |
|---|---|---|---|---|---|
| 87703 | Depending on the module selected | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

[71] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[72] | Determination of Module Grades | Comments |
|---|---|---|---|
| 87703 | Depending on the module selected | | |
| | | | |

**Requirements for Admission to the Module Exam**

Depending on the module selected

**Comments**

none

**Last Update**: TT.MM.JJJJ, Prof. Dr.

[72] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*

| | |
|---|---|
| **Course of studies** | Mechatronics Engineering (B. Eng.) |
| **Module name** | Studium Generale |
| **Module Coordinator** | Dean of Studies |
| **Module type** | Compulsory module |
| **Semester** | 7. semester |
| **Duration** | During the study |
| **No. of lectures** | |
| **Begin of offer** | Winter semester, Summer semester |
| **Credits** | 3 CP |
| **Workload Contact time** | 90 hours |
| **Workload Self study** | |
| **Admission requirement** | |
| **Relevance in courses of study** | |
| **Language** | English |

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## Module Number: 87999 SPO version: 34

## Studium Generale

**Learning goals/ competence**

The comprehensive education of students is expanded by courses from the Studium Generale. These courses complement the respective degree with interdisciplinary subjects. The program enables students to deal with general scientific subjects and current topics.

Students acquire essential qualifications relevant for their later professional life. Volunteering is encouraged to build on the social skills of students.

**Professionalism**

Students are able to present complex interdisciplinary subjects and can assess their relationships. They are able to deal autonomously with socio-political questions.

**Interdisciplinary skills**

Depending on their choice of courses, students improve their teamworking skills, their time and/or conflict management or their presentation skills. Students are enabled to apply attained skills as requested.

Students acknowledge the significance of voluntary commitment to personal development and to society.

**Lecture contents**

Various courses and events are offered as part of the General Studies. Each semester has a thematic focus. The respective course content is flexible and can therefore be taken from the respective program created every semester.

The courses can be attended by students at any time during their studies, but at the latest in the last semester.

In order to count the corresponding hours and credit points, a collection sheet of the workload performed as well as a written report on the completed courses must be submitted. Alternatively, voluntary or civil society commitment during studies can be performed, documented and credited. Corresponding information can be found in the “Aalen University Guidelines of the General Studies and the Achievement of Social Competence“.

**Literature**

Depending on choice of courses

**Courses / lectures** (LV)

| Course no. | Title of the course / lecture | Lecturer | Type [73] | Semester hours per week | CP |
|---|---|---|---|---|---|
| 87999 | Depending on choice of courses | | | | 3 |

**Module exam**

| Course no. | Type / length[74] | grading | Comments |
|---|---|---|---|
| 87999 | PLS | Not graded | Report |

**Admission requirement**

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**Comments**:

**Last updated**: TT.MM.JJJJ, Prof. Dr. Holger Schmidt

## Module Number: 99999 SPO-Version: 34

## Bachelor Thesis

| | |
|---|---|
| **Degree Program** | Mechatronics Engineering (B. Eng.) |
| **Module Manager** | Dean of Studies |
| **Modul Type** | Mandatory Module |
| **Academic Semester** | 7. Semester |
| **Module Duration** | 1 Semester |
| **Number LV** | 1 |
| **Offered** | Winter Semester |
| **Credits** | 12 CP |
| **Workload Class** | |
| **Workload Self-Study** | 360 Hours |
| **Participation Requirements** | See SPO |
| **Use in other SG** | |
| **Language** | English |

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**Module Objectives**

**Professional competence:**

Students can work on a task independently and comprehensively and solve specific tasks and questions using engineering procedures. Independent processing and solution of a given task from the problem definition and literature research to analysis, physical interpretation and presentation of the results. The working method is designed in such a way that students are first able to narrow down the problem and to develop adequate solution methods and tools. The work should not be one-sided and in-depth, but should solve the task in consideration of the relevant boundary conditions.

**Interdisciplinary competence:**

Students can contribute to the team and communicate in an appropriate manner.

**Special methodological competence, if applicable:**

They know the basic procedure for solving problems.

**Course Content**

From the thematic environment of the course content

**Literature**

- Technical: to be discussed with supervisor
- Organizational: Handout of the degree program

**Included Courses** (LV)

| LV-Nr. | Course Name | Professor | Type[75] | SWS | CP |
|---|---|---|---|---|---|
| 9999 | Bachelor Thesis | Professors of the degree program | P | | 12 |

**Module Examination** (Prerequisite for the Award of Credit Points)

| LV-Nr. | Type and Duration of Proof of Performance[76] | Determination of Module Grades | Comments |
|---|---|---|---|
| 9999 | *PLP* | 100% | two supervisors (to be sought by students) |

**Requirements for Admission to the Module Exam**

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**Further Study-Related Feedback**

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**Comments**

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**Last Update**: 01.08.2024, Prof. Dr. Holger Schmidt

[75] *Type of course according to: Allgemeiner Teil der SPO (§ 63 BA-TA-18-1; § 55 MA-TA-20-1).*
[76] *Types of examinations according to: Allgemeiner Teil der SPO (§ 20a BA-TA-18-1; § 18a MA-TA-20-1).*