HOCHSCHULE HEILBRONN

# Module Handbook

Faculty of Engineering (TE),
Automotive Systems Engineering (ASE) degree programme leading to a Bachelor of Engineering (B.Eng.)

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| Date of introduction: Programme coordinator: | 1 September 2025<br>Prof. Dr.-Ing. Nicolaj Stache |
| Date of creation: Workload: SPO: | 29 January 2026<br>210 ECTS<br>4 |

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# Aims of the degree programme Automotive Systems Engineering

The Automotive Systems Engineering degree programme combines methodologically sound fundamental and specialist knowledge from the fields of mechanics, electronics and computer science with the aim of providing students with practical, interdisciplinary knowledge in automotive engineering. Students will
be equipped to design and oversee complex vehicle and mobility systems, and to manage the entire development and project management process throughout the product lifecycle.

Only the optimal interaction of diverse technical components from different disciplines makes the vehicle what is expected of it today: a safe,
efficient, environmentally friendly and user-oriented means of transport that offers driving pleasure, prevents accidents and provides optimum protection in the event of an emergency. Anyone wishing to develop such a vehicle needs to see the bigger picture – and that is precisely what the Automotive Systems Engineering degree programme is all about.

## Systems Engineering as the Core Approach

Systems engineering is an engineering discipline focused on the structured and goal-oriented development of complex systems with an interdisciplinary approach. Anyone wishing to develop such systems must think holistically, proceed in a targeted manner and apply methods that help to manage complexity. This is why the development departments of major
car manufacturers have dedicated departments known as ‘Automotive Systems Engineering’. Students

are prepared to:

- to think and act in an interdisciplinary manner,
- to contribute to teams comprising different disciplines,
- to confidently apply methods such as analysis, planning, modelling and efficient project management,
- combine specialist knowledge from electronics, mechanics/design, software development, communications, and measurement and control engineering.

Close collaboration with industry is ensured through endowed professorships, active participation by companies on the advisory board and in appointment committees, and through practice-oriented courses.

## Learning outcomes for graduates

Graduates of the programme should be able to:

- to analyse, structure and design systems-related contexts,
- Work in an interdisciplinary manner,
- to cooperate effectively within a team,
- To contribute to the product development process in the automotive industry (manufacturers, system suppliers, component suppliers), particularly at system interfaces – e.g. in specification, integration, application and testing,
- to apply technical principles from electronics, mechanics and information technology with confidence,
- to apply methodological skills in project management, systems engineering and quality assurance.

In addition, they acquire the ability to take personal responsibility, to reflect on the consequences of their actions and to engage in continuous professional development – a must for engineers in a rapidly changing world of mobility.

## Programme Profile and Career Prospects

The degree programme provides broad, cross-sector engineering knowledge with a focus on the systemic analysis of complex technical products. This means that graduates are qualified not only for roles in the automotive industry, but also in fields such as mechanical engineering, automation technology, robotics, and energy and transport systems.

Thanks to the high proportion of practical work (practical study semester, project work, laboratory exercises, field trips, final dissertation in collaboration with companies) and the close links to industry, career prospects are excellent. In the Heilbronn area in particular, there are many innovative companies that are experiencing strong growth in the field of systems engineering.

## Innovation and distinctive features

A unique selling point is the in-depth exploration of the development methodology for complex systems. Product development in the automotive industry today is:

- Model-based – utilising modern simulation and modelling methods,
- Distributed – with globally networked development and manufacturing teams,

- Process-oriented – following standardised and efficient development processes.

Current topics such as electromobility, automated and connected driving, digital twins and sustainable mobility concepts are firmly embedded in the degree programme.

## International focus

The automotive industry is globally interconnected. For this reason, the degree programme specifically promotes
stays abroad, exchange programmes and international collaborations. English as the working language, intercultural competence and experience in international project teams are key educational objectives. Collaborations exist with both European and
non-European partner universities and companies.

# Modules and courses on the programme

| Type | Name | Coordinator(s) |
|---|---|---|
| Module | Mathematics 1 | Prof. Dr Volker Stahl |
| Course | Mathematics 1 | Prof. Dr Volker Stahl |
| Module | Mathematics 2 | Prof. Dr Volker Stahl |
| Course | Mathematics 2 | Prof. Dr Volker Stahl |
| Module | Physics and Fundamentals of Engineering | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Course | Engineering Physics | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Course | Fundamentals of Design | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Module | Measurement Technology | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Fundamentals of Measurement Technology | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Physical Measurement Technology Laboratory | Prof. Dr.-Ing. Carsten Pargmann |
| Module | Computer Science and Digital Technology | Dieter Hägele |
| Course | Computer Science and Digital Technology | Dieter Hägele |
| Module | Computer Science 2 | Prof. Dr.-Ing. Ansgar Meroth |
| Course | Computer Science 2 | Prof. Dr.-Ing. Ansgar Meroth |
| Module | Electrical Engineering 1 | Prof. Dr.-Ing. Peter Reiser<br>Prof. Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Course | Electrical Engineering 1 | Prof. Dr.-Ing. Peter Reiser<br>Prof. Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Module | Electrical Engineering 2 | Prof. Dr.-Ing. Peter Reiser<br>Prof. Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Course | Electrical Engineering 2 | Prof. Dr.-Ing. Peter Reiser<br>Prof. Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |

| Degree | Programme | Automotive Electronics and Electronic Circuit Technology | Prof. Dr.-Ing. Peter Reiser |
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| Course | Automotive Electronics and Electronic Circuit Technology | Prof. Dr.-Ing. Peter Reiser |
| Course | Electrical Engineering Laboratory | Prof. Dr.-Ing. Peter Reiser |
| Module | Engineering Mechanics 1 | Prof. Dr.-Ing. Klaus Leimbach |
| Course | Engineering Mechanics 1 | Prof. Dr.-Ing. Klaus Leimbach |
| Module | Engineering Mechanics 2 + 3 | Prof. Dr.-Ing. Klaus Leimbach |
| Course | Engineering Mechanics 2 | Prof. Dr.-Ing. Klaus Leimbach |
| Course | Engineering Mechanics 3 | Prof. Dr.-Ing. Klaus Leimbach |
| Module | Automotive Engineering | |
| Course | Automotive Engineering 1 | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Course | Automotive Engineering 2 | Prof. Dr.-Ing. Georg von Tardy-Tuch |
| Module | Mathematics 3 | Prof. Dr Volker Stahl |
| Course | Mathematics 3 | Prof. Dr Volker Stahl |
| Module | Modelling and Thermodynamics | Prof. Dr.-Ing. Klaus Leimbach |
| Course | Modelling | Prof. Dr.-Ing. Klaus Leimbach |
| Course | Thermal and Fluid Dynamics | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Module | Simulation Technology | Prof. Dr.-Ing. Andreas Daberkow |
| Course | Simulation Technology | Prof. Dr.-Ing. Andreas Daberkow |
| Module | Signals and Systems | Prof. Dr.-Ing. Frank Tränkle |
| Course | Signals and Systems | Prof. Dr.-Ing. Frank Tränkle |
| Module | System Dynamics | Prof. Dr.-Ing. Georg von Tardy-Tuch |
| Course | System Dynamics | Prof. Dr.-Ing. Georg von Tardy-Tuch |
| Module | Measurement Technology and Sensors | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Measurement Technology and Sensors | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Control Engineering | Prof. Dr.-Ing. Frank Tränkle |
| Course | Control Engineering | Prof. Dr.-Ing. Frank Tränkle |
| Module | Control Engineering Laboratory | Prof. Dr.-Ing. Frank Tränkle |
| Course | Control Engineering Laboratory | Prof. Dr.-Ing. Frank Tränkle |
| Module | Modelling and Simulation Laboratory & Measurement Technology Laboratory | Prof. Dr.-Ing. Frank Tränkle |

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| Course | Modelling and Simulation Laboratory | Prof. Dr.-Ing. Frank Tränkle |
| Course | Measurement Technology Laboratory | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Microcontrollers & Networks | Prof. Dr.-Ing. Ansgar Meroth |
| Course | Microcontrollers & Networks | Prof. Dr.-Ing. Ansgar Meroth |
| Module | Software Engineering | Dr Mihai Kocsis |
| Course | Software Engineering | Dr Mihai Kocsis |
| Module | Introduction to AI | Prof. Dr. rer. nat. Marco Wagner |
| Course | Introduction to AI | Prof. Dr. rer. nat. Marco Wagner |
| Module | Systems Engineering – Management and Accounting | Prof. Dr. Ing. Ansgar Meroth |
| Course | Systems Engineering and Management | Prof. Dr.-Ing. Ansgar Meroth |
| Course | Accounting | Dr Elena Dickert |
| Module | General Studies | Prof. Dr.-Ing. Nicolaj Stache |
| Course | General Studies | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Practical study semester | Prof. Dr Volker Stahl |
| Course | Supervised practical placement | Prof. Dr Volker Stahl |
| Course | Colloquia accompanying the practical study semester | Prof. Dr Volker Stahl |
| Module | Seminar paper and project management | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Seminar paper | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Project Management | Ines Marquardt-Schmidt |
| Module | Specialist Studies 1 | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Elective(s) in accordance with Section 3.2 | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Specialist Studies 2 | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Elective(s) in accordance with Section 3.2 | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Specialist Specialisation 3 | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Elective(s) in accordance with Section 3.2 | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Specialist Specialisation 4 | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Elective(s) in accordance with Section 3.2 | Prof. Dr.-Ing. Nicolaj Stache |

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| Module | Specialist Specialisation 5 | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Elective(s) in accordance with Section 3.2 | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Specialist Specialisation 6 | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Elective(s) in accordance with Section 3.2 | Prof. Dr.-Ing. Nicolaj Stache |
| Module | Bachelor's Thesis / Project | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Bachelor's Thesis / Project | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Project Planning and Colloquium | Prof. Dr.-Ing. Nicolaj Stache |
| Course | Project Planning and Colloquium | Prof. Dr.-Ing. Nicolaj Stache |

# Module 610010 Mathematics 1

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| Course coordinator | Prof. Dr Volker Stahl |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 6 |
| Requirements for the award of credit points | LK 90 |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | see course(s) |
| Course content | The 'Mathematics 1' module covers a wide range of topics focusing on fundamental mathematical concepts and methods. Key areas include set theory, with its associated relations and functions, as well as the composition of functions and their inverse functions. Complex numbers are also covered, with the focus on their arithmetic and geometry. Limits, differential and integral calculus form another important component, encompassing the analysis of functions and their properties. Polynomials, rational functions and their algebraic methods, such as polynomial division and partial fraction decomposition, are also a central topic. |
| Intended learning outcomes | Students will have a firm grasp of fundamental mathematical concepts such as set theory, complex numbers, vectors and functions, as well as integral and differential calculus. They will be able to carry out complex arithmetic operations and solve mathematical problems both independently and as part of a team. Through group-based learning, they will be able to apply the specialist knowledge they have acquired and further deepen their understanding. |

# Course 610011 Mathematics 1

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|---|---|
| Course coordinator | Prof. Dr Volker Stahl |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 6 |
| Requirements for the award of credit points | Module examination |
| Assessment in the case of a combined examination | |
| Entry requirements | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | • Set theory, relations, functions, composition of functions, inverse functions<br>• Complex numbers<br>• Limits, differential and integral calculus<br>• Polynomials, rational functions, polynomial division, partial fraction decomposition<br>• Vector calculus<br>• Systems of linear equations<br>• Matrices |
| Subject-specific competence: knowledge and understanding | Students have a firm grasp of the fundamentals of set theory, complex numbers, vectors, matrices, properties of functions, and integral and differential calculus. |
| Subject-specific competence: Skills, knowledge acquisition | Students have a command of arithmetic operations involving complex numbers, vectors, matrices, functions of one and several variables, as well as integral and differential calculus. |
| Personal competence: Social competence | Students learn to work in groups and to solve mathematical problems both independently and as part of a team. |
| Personal competence: Independence | Students are able to apply the specialist knowledge they have learnt and to deepen their mathematical understanding independently. |
| Literature/Learning resources | • Lecture notes |

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| | • Glatz, Grieb, Hohloch, Kümmerer: Bridges to Mathematics, Volumes 1–5, Cornelsen<br>• Burg, Haf, Wille: Advanced Mathematics for Engineers, Teubner<br>• Papula: Mathematics for Engineers, Springer |

# Module 610020 Mathematics 2

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|---|---|
| Lecturer | Prof. Dr Volker Stahl |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Mathematics 2' module covers fundamental concepts from linear functionals, vector spaces and differential equations. These include the analysis of linear independence and the solution of ordinary differential equations. Further focus is placed on the solution of linear time-invariant systems and convolution. In addition, Fourier series and their connections to the Fourier transform are covered. |
| Intended learning outcomes | Upon completion of the 'Mathematics 2' module, students will be able to solve complex linear equations and systems, and to apply Fourier series and transforms. They will be able to analyse and develop vector spaces, functions of several variables and periodic functions using Fourier series. Furthermore, they will be able to solve mathematical problems independently and work effectively in groups. |

# Course 610021 Mathematics 2

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|---|---|
| Course coordinator | Prof. Dr Volker Stahl |
| Frequency of offering | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Entry requirements | Prior knowledge from Mathematics 1 |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | • Linear functions, linear independence and vector spaces<br>• Ordinary differential equations<br>• Linear, time-invariant systems and convolution<br>• Fourier series<br>• Fourier transform |
| Subject-specific competence: knowledge and understanding of | Students have understood the concept linear independence, as well as the concepts of basis and dimension of vector spaces. Students are able to solve ordinary differential equations and understand the relationship between linear differential equations, linear systems and convolution. They know the applications of Fourier series and the Fourier transform. |
| Subject-specific competence: Skills, knowledge acquisition | Students are proficient in working with vector spaces, functions of several variables and the expansion of periodic functions into Fourier series. They are familiar with Fourier series and the Fourier transform and are able to solve differential equations |
| Personal competence: Social competence | Students develop their ability to work in groups and solve problems as part of a team. |
| Personal competence: Independence | Students are able to apply the and to develop their mathematical knowledge independently. |

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| Literature/Learning resources | • Lecture notes<br>• Burg, Haf, Wille: Advanced Mathematics for Engineers, Teubner<br>• Papula: Mathematics for Engineers, Springer |

# Module 610030 Physics and Fundamentals of Engineering

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment in a combined examination | see course(s) |
| Requirements for participation | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The module 'Fundamentals of Physics and Engineering' covers two main areas: thermodynamics and heat transfer, and engineering.<br>Thermodynamics deals with systems, state and process variables, thermal conduction and heat transfer. The engineering section covers concepts such as scope definitions, design requirements and conceptualisation, strength analysis and materials, descriptive geometry and technical drawings.<br>These fundamentals form the basis for the rest of the course content. |
| Intended learning outcomes | Students will be able to apply physical laws and principles to analyse and understand complex systems. They will be able to draw up energy balances and relate them to other approaches in order to understand the principles of energy balancing.<br>Furthermore, they can use specialist vocabulary in English correctly and structure complex concepts by using note sheets as an aid. By deepening their skills through dialogue with lecturers and fellow students, they are able to understand and communicate new concepts. |

# Course 610031 Technical Physics

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| Course coordinator | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | Introduction to thermodynamics and heat transfer<br>• Thermodynamic systems, state and process variables<br>• Expansion of liquids, ideal gas law<br>• First law of thermodynamics, work and heat, internal energy, enthalpy<br>• Heat conduction, heat exchangers |
| Subject-specific competence: knowledge and understanding | Students are familiar with state variables<br>temperature, pressure and specific volume, and the relationships between them. They can apply the First law of thermodynamics and are familiar with energy-related process and state variables for both closed and open systems.<br>They are familiar with the fundamentals of heat transfer. |
| Professional competence: Skills, knowledge acquisition | The fundamental<br>fundamental principle of balancing, which is essential in systems engineering, is practised using energy balances and related to other balancing approaches.<br>Key technical vocabulary in English is introduced as a compulsory part of the course and explained in linguistic terms. |
| Personal competence: Social competence | Students deepen their ability to<br>dialogue with the lecturer and fellow students |

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| Personal competence: Independence | Through the use of an individual, limited-capacity notepad as the sole aid in the exam, students are indirectly encouraged to summarise the subject matter they have learnt concisely and to structure it in the process |
| Bibliography/Learning resources | Windisch, Herbert: 'Technical Thermodynamics', Oldenbourg Verlag |

# Course 610032 Fundamentals of Design

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|---|---|
| Lecturer | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | Introduction to engineering, with a particular focus on design<br>• Scope; requirements, design, specification<br>• Introduction to strength analysis and materials<br>• Descriptive geometry, projections, technical drawings, tolerances |
| Professional competence: knowledge and understanding | Using examples, students learn to how to represent components in various views and, where appropriate, to dimension them.<br>Students practise, using examples, devising concepts for simple technical systems and drawing up specifications. |
| Professional competence: Skills, knowledge acquisition | Key technical vocabulary in English are introduced as compulsory and explained in linguistic terms. |
| Personal competence: social skills | Students deepen their ability to understand and correctly apply new terms in dialogue with the lecturer and fellow students |
| Personal competence: independence | Through the use of a individual, limited-volume notepad – the only resource provided for this purpose in the exam – indirectly requires students to summarise the subject matter they have learnt concisely and to structure it in the process |
| Literature/Study resources | Hoischen, ‘Technical Drawing’ |

# Module 610040 Measurement Technology

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| Person(s) responsible | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | LK 60, SL |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | see course(s) |
| Course content | The 'Measurement Technology' module covers the fundamental principles of measurement and measurement errors. The course content covers the fundamentals of measurement, such as calculating with units and powers of ten, as well as distinguishing between direct and indirect measurement. Measurement systems and errors, causes of measurement deviations, and methods for error handling – such as regression analysis and RANSAC – are also discussed.<br>Finally, the module covers the handling of outliers and the analysis of measurement signals, including the time and frequency domains as well as noise. |
| Intended learning outcomes | Upon completion of the 'Measurement Technology' module, students will be able to make scientifically sound decisions in measurement applications. They will be able to evaluate measurement data, identify errors and analyse their causes to ensure that measurement results are accurate and reliable.<br>In addition, they will have an understanding of measurement signals and their representation in the frequency domain, as well as the ability to apply the material covered in exercises and transfer it to other use cases. |

# Course 610041 Fundamentals of Measurement Technology

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | LK 60 |
| Assessment in the case of a combined examination | |
| Requirements for participation | - |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | •What is measurement? Fundamental quantities and units<br>•Calculating with units, powers of ten<br>•Direct vs. indirect measurement<br>•Measurement systems and measurement errors<br>•Causes of measurement deviations<br>•Distributions: normal distribution, Student's distribution<br>•Error propagation<br>•Regression analysis, RANSAC<br>•Outlier handling<br>•Measurement signals: time/frequency domain, noise |
| Subject-specific competence: Knowledge and understanding | Students are able to use the fundamental concepts of measurement technology with confidence; they are familiar with<br>and their causes.<br>Furthermore, students are able to deduce relationships from the measurement data obtained, even in the presence of interference and outliers.<br>Finally, students have acquired a basic understanding of measurement signals and their representation in the frequency domain. |
| Professional competence: Skills, knowledge acquisition | Students have the ability to<br>apply the material taught in exercises and transfer it to other practical scenarios. |

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| Personal competence: Social competence | Students learn to address metrological issues in small groups. |

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| Personal competence: Independence | Students are able to<br>and to apply or expand upon it independently. |
| Literature/Learning resources | • Elmar Schrüfer, Leonhard M. Reindl, Bernhard Zagar: Electrical Measurement Technology: Measurement of Electrical and Non-Electrical Quantities, 11th<br>edition, Hanser, 2014.<br><br>• Reinhard Lerch: Electrical Measurement Technology: Analogue, Digital and Computer-Aided Methods, 6th edition, Springer Vieweg, 2012<br><br>• Rainer Parthier: Measurement Technology, 8th edition, Springer, 2016. |

# Course 610042 Laboratory in Physical Measurement Technology

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| Course coordinator | Prof. Dr.-Ing. Carsten Pargmann |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | SL |
| Proof of achievement in a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | L/S – Conducting experiments in groups of 2–3 students in accordance with the syllabus. Submission of reports on each experiment. |
| Course content | Classic physics experiments with a focus on measurement techniques |
| Subject-specific competence: knowledge and understanding | Learning how to handle measurement data and evaluation. Methods for comparing theory and experiment, including parameter identification. |
| Subject-specific competence: Skills, knowledge acquisition | Learning basic and advanced experimental techniques. Practising the interpretation of phenomena. |
| Personal competence: Social competence | Promoting the ability to work in a team |
| Personal competence: independence | Promoting independent work |
| Literature/learning resources | Walcher: Practical Course in Physics |

# Module 610050 Computer Science and Digital Technology

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| Person(s) responsible | Dieter Hägele |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 90 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Computer Science and Digital Technology' module covers a wide range of topics that provide fundamental knowledge in computer science and digital technology. Key topics include Boolean algebra, digital circuits, automata, data types and variables, as well as algorithms and programming languages (PAP). Operators and functions, control structures, streams and I/O, as well as strings, containers and recursion, round off the spectrum. These topics provide the necessary logic and semantic depth to solve complex problems in computer science and digital technology. |
| Intended learning outcomes | Upon completion of the 'Computer Science and Digital Technology' module, students will be able to solve complex problems using C++, design circuit networks and automata, and write procedural programmes. They will have a firm grasp of the fundamental concepts of digital technology and be able to apply this knowledge. Furthermore, they will be able to work and learn to further develop solutions in order to communicate effectively with fellow engineers at a technical level. |

# Course 610051 Computer Science and Digital Technology

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|---|---|
| Course coordinator | Dieter Hägele |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | Lecture with exercises and case studies. |
| Course content | •Boolean algebra<br>•Circuit networks<br>•Automata<br>•Data types and variables<br>•Algorithms and PAP<br>•Operators and functions<br>•Control structures<br>•Streams and I/O<br>•Strings<br>•Containers<br>•Recursion |
| Subject-specific competence: knowledge and understanding | Students will be familiar with:<br>•Boolean algebra<br>•the structure of switching networks and finite automata<br>•the fundamentals of procedural programming<br>•data types and containers in C++<br>•control structures<br>•the importance of streams in C++<br><br>Students will be able to: |

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| | •design switching networks and automata using simple methods<br>•Use data types and operators correctly<br>•create and apply functions<br>•solve simple problems using C++ |
| Subject-specific competence: Skills, knowledge acquisition | Students have mastered the the fundamental concepts of digital technology and procedural programming and are able to apply this knowledge. |
| Personal competence: Social competence | Students learn to work responsibly in teams and to further develop solutions. They are able to communicate with fellow engineers on a technical level using the specialist terminology covered in the lecture. |
| Personal competence: Independence | Students acquire the problem-solving skills required to tackle IT-related tasks independently. |
| Literature/Learning resources | •Wöstenkühler, G.: Fundamentals of Digital Technology – Basic Components, Functions and Control Systems, fv-Hanser, Leipzig 2024<br>•Breymann, U.: C++, Hanser, Munich 2023<br>•Wolf, J.; Guddat, M.: Introductory Course in C++, Rheinwerk Computing, Bonn 2025<br>•Lecture notes |

# Module 610060 Computer Science 2

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Ansgar Meroth |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Computer Science 2' module covers concepts of object-oriented programming in C++ and the STL, such as templates, pointers, references and iterators. Polymorphism, operator overloading, trees with search and sort algorithms, queues and linked lists are also covered. In addition, complexity analysis is discussed in the context of algorithms and data structures. |
| Intended learning outcomes | Upon completion of the "Computer Science 2" module, students will be able to analyse and process complex information by:<br><br>design and implement classes and relationships in C++.<br><br>using templates and the STL to implement efficient algorithms.<br><br>design and describe linked lists, queues and trees.<br><br>apply the most important sorting and searching algorithms.<br><br>Solve and implement complex tasks in C/C++ by having learnt structured programming within the context of object-oriented programming.<br><br>By acquiring these skills, students will be able to independently |

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| | tackle IT-related problems and further develop solutions. |

# Course 610061 Computer Science 2

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| Person(s) responsible | Prof. Dr.-Ing. Ansgar Meroth |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with exercises and case studies. |
| Course content | • Concepts of object-oriented programming in C++, STL, templates<br>• Pointers/references/iterators<br>• Polymorphism<br>• Operator overloading<br>• Trees, search and sort algorithms<br>• Queues<br>• Linked lists<br>• Complexity analysis |
| Subject-specific competence: knowledge and understanding | Students are able to<br>• Design classes and relationships and implement them in C++<br>• Work with templates and the STL<br>• Design linked lists, queues and trees<br>• describe the most important sorting and searching algorithms |
| Subject-specific competence: skills, knowledge acquisition | Students can solve more complex problems and implement them in a C / C++ programme. Furthermore, based on the fundamentals of object-oriented programming, they have learnt structured programming and are able to create software projects comprising multiple programmes and the integration of libraries. |

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| Personal competence: Social competence | Students acquire the problem-solving skills required to tackle IT-related tasks independently. |
| Personal competence: Independence | Students learn to work responsibly and to further develop solutions. |
| Literature/Learning resources | Detailed lecture notes, C++ learning materials selected by the students |

# Module 610070 Electrical Engineering 1

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| Course co-ordinators | Prof. Dr.-Ing. Peter Reiser Prof.<br>Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | LK 90 |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | see course(s) |
| Course content | The 'Electrical Engineering 1' module covers fundamental knowledge in electrical engineering. The focus is on direct current circuits, the measurement of current and voltage, and calculation methods. Electric and magnetic fields are examined, with a particular emphasis on steady-state fields and capacitors.<br>The processes of charging and discharging capacitors are also covered. This knowledge forms the basis for further electrical engineering modules. |
| Intended learning outcomes | Upon completion of the "Electrical Engineering 1" module, students will be able to analyse and calculate simple electrical relationships and describe basic circuits mathematically. They will be able to present arguments on complex problems in a subject-specific manner and collaborate with specialists in expert teams. Furthermore, they will be able to reflect on, evaluate, independently pursue and take responsibility for their own learning objectives. |

# Course 610071 Electrical Engineering 1

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|---|---|
| Course Coordinator | Prof. Dr.-Ing. Peter Reiser Prof.<br>Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Module examination |
| Assessment in a combined examination | |
| Entry requirements | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | • Direct current circuits<br>• Current and voltage measurement<br>• Calculation methods<br>• Electric field<br>• Steady-state electric field and capacitors<br>• Charging and discharging of capacitors |
| Subject-specific competence: Knowledge and understanding | Students understand the fundamental principles of electrical engineering. They are able to understand simple electrical concepts, analyse circuits and perform calculations on them. |
| Professional competence: Skills, knowledge acquisition | The aim of the course is to provide a fundamental understanding of electrical engineering. Students acquire the ability to describe basic circuits mathematically and to derive the corresponding mathematical equations. |
| Personal competence: Social competence | To present complex subject-related problems and solutions to experts in a reasoned manner and, where appropriate, to develop them further in collaboration with them within expert teams. |
| Personal competence: Independence | To reflect on, evaluate, pursue in a self-directed manner and take responsibility for one's own learning and work objectives, as well as those set by others. |

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| Literature/Learning resources | • M. Marinescu: Electric and Magnetic Fields, Springer, Berlin<br>• M. Marinescu, N. Marinescu: Electrical Engineering for Study and Practice, Springer, Wiesbaden<br>• G. Hagmann: Fundamentals of Electrical Engineering, Aulaverlag, Wiebelsheim<br>• G. Hagmann: Collection of Exercises on the Fundamentals of Electrical Engineering, Aulaverlag, Wiebelsheim<br>• Ose, Rainer: Electrical Engineering for Engineers, Fachbuchverlag Leipzig<br>• Altmann, Siegfried and Schlayer, Detlef: Textbook and Workbook on Electrical Engineering, Fachbuchverlag Leipzig |

# Module 610080 Electrical Engineering 2

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|---|---|
| Responsible person | Prof. Dr.-Ing. Peter Reiser<br>Prof. Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 90 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Electrical Engineering 2' module covers the fundamentals required to understand complex electrical systems. Magnetic fields and induction processes are central to understanding how alternating signals work. Complex alternating current calculations form the basis for understanding reactance, active and reactive power, and transformers.<br>Three-phase systems are examined as an example of practical application to put the theories into practice. |
| Intended learning outcomes | Students will be able to analyse and calculate complex electrical systems. They will be able to formulate mathematical equations to describe and solve circuit problems. Working in teams, they will develop and discuss problems and solutions, and reflect on their own learning objectives and outcomes. Through independent study, they will monitor and take responsibility for their own learning progress in order to work effectively in the field of electrical engineering. |

# Course 610081 Electrical Engineering 2

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|---|---|
| Course Coordinator | Prof. Dr.-Ing. Peter Reiser<br>Prof. Dr.-Ing. Michael Kokes<br>Prof. Dr.-Ing. Rainer Uhler |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with integrated practical sessions |
| Course content | • Magnetic field<br>• Induction processes<br>• Description of alternating electrical signals<br>• Fundamentals of complex alternating current calculations<br>• Reactive resistance<br>• Active and reactive power<br>• Transformers<br>• Three-phase system |
| Professional competence: knowledge and understanding | Students understand the interrelationships in electrical engineering. They are able to understand complex electrical concepts, analyse circuits and perform the necessary calculations. |
| Professional competence: Skills, knowledge acquisition | Students acquire the ability to describe more complex circuits mathematically and to derive the corresponding mathematical equations. |
| Personal competence: Social competence | Subject-related problems and solutions and to develop them further as part of a team. |

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| Personal competence: Independence manner and take responsibility for | Reflect on, evaluate, pursue in a self-directed<br><br>reflect on, evaluate, pursue in a self-directed manner and take responsibility for. |
| Literature/Learning resources | • M. Marinescu: Electric and Magnetic Fields, Springer, Berlin<br><br>• M. Marinescu, N. Marinescu: Electrical Engineering for Study and Practice, Springer, Wiesbaden<br><br>• G. Hagmann: Fundamentals of Electrical Engineering, Aulaverlag, Wiebelsheim<br><br>• G. Hagmann: Collection of Exercises on the Fundamentals of Electrical Engineering, Aulaverlag, Wiebelsheim<br><br>• Ose, Rainer: Electrical Engineering for Engineers, Fachbuchverlag Leipzig<br><br>• Altmann, Siegfried and Schlayer, Detlef: Textbook and Workbook on Electrical Engineering, Fachbuchverlag Leipzig |

# Module 610090 Automotive Electronics and Electronic Circuit Technology

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|---|---|
| Person(s) responsible | Prof. Dr.-Ing. Peter Reiser |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | LK 90, SL |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The module 'Automotive Electronics and Electronic Circuit Technology' covers fundamental principles of electronics, such as diode circuits, transistor circuits and operational amplifier circuits. The specific requirements for automotive control units and measurement technology are also covered. In addition, the basic circuits of direct current and alternating current technology are examined, with an analysis of the frequency response of passive components and the transfer characteristics of filters. |
| Intended learning outcomes | Students will gain a comprehensive understanding of electronic circuit technology and be able to apply this to electronic systems in motor vehicles. They will be able to analyse, evaluate and commission electronic systems, as well as carry out and document measurements. Through independent study and group work, they will acquire the skills to solve engineering problems and to communicate with fellow specialists. |

# Course 610091 Automotive Electronics and Electronic Circuit Technology

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|---|---|
| Course Coordinator | Prof. Dr.-Ing. Peter Reiser |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of course credits | 90 |
| Assessment based on a combined examination | |
| Entry requirements | |
| Teaching and learning methods | L/P – Lecture with integrated exercises and case studies |
| Course content | Electronic components, fundamental circuit principles,<br>diode circuits, transistor circuits, operational amplifier circuits,<br>Electronic systems in motor vehicles,<br>Specific requirements for automotive control units |
| Professional competence: knowledge and understanding | Students acquire a fundamental understanding of electronic circuit technology. They are able to apply this to electronic systems in motor vehicles. |
| Professional competence: Skills, knowledge acquisition | Students will master the skills to design, evaluate and classify electronic systems in motor vehicles |
| Personal competence: Social competence | Students work on electronic tasks in small groups and are able to discuss engineering issues with fellow students. |
| Personal competence: Independence | Students are able to deepen their specialist knowledge independently and can assess and pursue learning content and objectives on their own. |
| Literature/Learning resources | • Wallentowitz/Reif, Handbook Automotive Electronics, Vieweg, Wiesbaden |

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| | • Krüger, Fundamentals of Automotive Electronics, Hanser, Munich<br><br>• Siegl Zocher: Circuit Design; Springer-Verlag, Berlin Heidelberg<br><br>• Reinhold, Wolfgang: Electronic Circuit Technology; Carl Hanser Verlag, Munich |

# Course 610092 Electrical Engineering Laboratory

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Peter Reiser |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | SL |
| Proof of achievement in a combined examination | |
| Requirements for participation students must | To take part in 'Electrical Engineering Laboratory',<br><br>"Electrical Engineering 1" must have been graded at least 'satisfactory'.<br><br>Preliminary assessment via laboratory work. |
| Teaching and learning methods | L/S – Laboratory |
| Course content | Basic circuits in direct current technology<br><br>• Standard measurement procedures and equipment<br><br>• Metrological analysis of circuits and their documentation<br><br>Basic circuits in alternating current technology<br><br>• Investigation of the frequency response of passive components<br><br>• Investigation of the transfer characteristics of filters (high-pass, low-pass)<br><br>Direct current machine<br><br>• Steady-state behaviour, characteristic curves |
| Subject-specific competence: knowledge and understanding and evaluate, using measurement techniques, simple | Students are able to construct, analyse electrical engineering circuits, analyse them and evaluate them using measurement techniques. They can document measurement series and are confident in using standard electrical engineering measuring instruments. |
| Professional competence: Skills, knowledge acquisition | |
| Personal competence: Social competence | |
| Personal competence: Independence | |

| Literature/learning resources |
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# Module 610100 Technical Mechanics 1

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|---|---|
| Person in charge | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of credit points | 90 LK |
| Assessment in the case of a combined examination | see course(s) |
| Requirements for participation | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Technical Mechanics 1' module covers the fundamentals of technical mechanics, including the axioms of statics, vector calculus and pairs of forces. The central theme is the decomposition of forces and conditions of equilibrium in planar systems. Beam structures are analysed, covering secure supports and the calculation of support reactions. Further topics include internal forces, moments, adhesion and friction, as well as key aspects relating to centres of mass, volume centres of mass, centres of area and line centres of mass. |
| Intended learning outcomes | Students will be able to analyse and solve complex mechanical problems. They will be familiar with the fundamentals of statics, kinematics and kinetics, as well as mechanical design elements. Through technical drawings, they will be able to structure, calculate and implement tasks. This will enable them to efficiently solve technical problems in the fields of mechanics and design and to successfully carry out technical projects. |

# Course 610101 Technical Mechanics 1

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|---|---|
| Lecturer | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisites for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture, group exercises during contact hours |
| Course content | Introduction,<br><br>Topics in Technical Mechanics<br>Fundamentals and axioms of statics,<br><br>Vector calculus, the concept of force, moment of a force,<br>Pairs of forces<br><br>Central and non-central planar systems of forces: resultant,<br><br>Force decomposition, conditions of equilibrium<br><br>Beam structures: supports, calculation of support reactions<br><br>Internal forces and moments, concentrated forces and distributed loads<br><br>Adhesion and friction: phenomena, calculation methods, self-locking, rope friction<br><br>Centre of mass: centre of mass of mass, volume, area and line<br><br>Stresses, strains, the law of elasticity Statically<br><br>indeterminate beam systems: stresses, rotations |
| Professional competence: knowledge and understanding | Students are familiar with the mechanical basic concepts of statics, kinematics and kinetics. Students are familiar with mechanical structural elements, can produce simple technical drawings and read more complex technical drawings. Building on this knowledge, |

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| | students can analyse, structure and calculate technical problems in the fields of mechanics and design, and demonstrate how these can be technically implemented. |
| Professional competence: Skills, knowledge acquisition | |
| Personal competence: social competence | |
| Personal competence: independence | |
| Literature/learning resources | Gross, Hauger, Schnell: Technical Mechanics 1; Springer Verlag<br><br>Holzmann, Meyer, Schumpich: Technical Mechanics, Part 1; Teubner Verlag<br><br>J., H. Dankert, Technical Mechanics, Teubner Verlag |

# Module 610110 Engineering Mechanics 2 + 3

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|---|---|
| Course Coordinator | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment in the case of a combined examination | See course(s) |
| Entry requirements | See course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The module 'Technical Mechanics 2 + 3' covers the course content from the modules on stresses, strains, distortions, the law of elasticity, bending, beam bending, torsion, shear, statically indeterminate truss systems, stresses, rotations, kinematics of a point, kinematics of a rigid body and kinetics of a mass point. The specific course content is:<br><br>- Law of elasticity and deformations<br><br>- Bending, Beam Bending, Torsion and Shear<br><br>- Kinematics of a point: position vector, velocity, acceleration, motion diagrams and description of motion in various coordinate systems<br><br>- Kinematics of a rigid body: translation, rotation, composite motion |
| Intended learning outcomes | Students will be able to analyse and solve complex mechanical problems by applying the fundamental concepts of statics, kinematics and kinetics. They will be able to understand technical problems in the fields of mechanics and design,<br>structure and calculate them, and demonstrate their technical implementation. |

# Course 610111 Technical Mechanics 2

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|---|---|
| Lecturer | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture, group exercises during contact hours |
| Course content | Stresses, strains, distortions, the law of elasticity<br><br>Bending, beam bending, line of bending, stiffness, torsion, shear, statically indeterminate beam systems<br><br>Stresses, rotations |
| Subject-specific competence: knowledge and understanding | Students are familiar with the mechanical<br><br>basic concepts of statics, kinematics and kinetics. Students are familiar with mechanical design elements, can produce simple technical drawings and read more complex technical drawings. Building on this knowledge, students can analyse, structure and calculate technical problems in the fields of mechanics and design, and demonstrate how these can be technically implemented. |
| Professional competence: Skills, knowledge acquisition | |
| Personal competence: Social competence | |
| Personal competence: Independence | |
| Literature/learning resources | Gross, Hauger, Schnell: Technical Mechanics 2; Springer Verlag<br><br>Holzmann, Meyer, Schumpich: Technical Mechanics, Part 2; Teubner Verlag<br><br>J., H. Dankert, Technical Mechanics, Teubner Verlag |

# Course 610112 Technical Mechanics 3

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | Module examination |
| Assessment in the case of a combined examination | |
| Entry requirements | |
| Teaching and learning methods | L/P – Lecture, group exercises during contact hours |
| Course content | Kinematics of a point: position vector, velocity,<br>acceleration, motion diagrams; description of motion in<br>different coordinate systems, rectilinear motion, circular motion,<br>general plane motion Kinematics of a rigid body: translation, rotation,<br>composite motion, centre of rotation, relative motion of a<br>point<br>Kinematics of a point mass: fundamental law of dynamics, work theorem, energy theorem,<br>Momentum, Power<br>Kinematics of a rigid body: translation, rotation, moment of inertia,<br>Centre of mass theorem, angular momentum theorem, work theorem, energy theorem, momentum theorem, power |
| Subject-specific competence: Knowledge and understanding | Students are familiar with the basic mechanical concepts of statics, kinematics and kinetics. Students are familiar with mechanical design elements, can produce simple technical drawings and read more complex technical drawings. Building on this knowledge, students analyse technical problems in the fields of mechanics and design, |

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| | structure and calculate them, and demonstrate how they can be technically implemented. |
| Professional competence: Skills, knowledge acquisition | |
| Personal competence: social competence | |
| Personal competence: independence | |
| Literature/learning resources | Gross, Hauger, Schnell: Technical Mechanics 3; Springer Verlag Holzmann, Meyer, Schumpich: Technical Mechanics, Part 3;<br><br>H. Dankert, Technical Mechanics, Teubner Verlag |

# Module 610120 Automotive Technology

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| Person(s) responsible | |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 LKBK |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The Automotive Engineering module covers an understanding of vehicle dynamics, including driving resistance, work and power. It covers the principles of gear ratios, gearboxes and gear-changing functions, as well as the powertrain configurations of internal combustion engines, hybrid vehicles and electric vehicles. In addition, steering types, aerodynamics and stabilisation concepts are analysed to deepen the understanding of axle configurations. |
| Intended learning outcomes | Upon completion of the 'Automotive Engineering' module, students will be able to analyse complex motion states of motor vehicles and understand how powertrain systems meet the requirements of the motion profile. They will be able to apply abstract concepts correctly and produce concise summaries of the subject matter covered. Furthermore, they will be able to identify and analyse aspects of vehicle dynamics, such as toe and camber, as well as the interaction with inertial and aerodynamic vehicle behaviour. |

# Course 610121 Automotive Engineering 1

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | Longitudinal dynamics of motor vehicles<br>• Driving resistances: aerodynamic, rolling, gradient and acceleration resistance<br>• Work, power, torque, longitudinal motion and rotation<br>• Gear ratios, gearboxes and gear-changing functions<br>• Characteristics of motor vehicle powertrains, principles of control in a 4-stroke engine |
| Professional competence: knowledge and understanding | Students learn to analyse the variety of modes of motion of a motor vehicle. In doing so, they explore how a powertrain meets the requirements of the motion profile. |
| Professional competence: Skills, knowledge acquisition | The fundamental<br>fundamental principle of balancing—which is essential in systems engineering—is practised using the longitudinal force balance in a motor vehicle, presented in diagrammatic form and thoroughly understood.<br>Key technical vocabulary in English is introduced as a compulsory part of the course and explained in linguistic terms. |
| Personal skills: Social skills | Students develop their ability to<br>understand and correctly apply abstract concepts in dialogue with the teacher and fellow students |
| Personal competence: Independence | Through the use of an<br>individual, limited-capacity<br>notepad as the sole aid in the exam, are indirectly encouraged to |

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| | subject content they have learnt and to structure it in the process |
| Literature/Learning resources | Haken, *Automotive Engineering*, Hanser-Verlag |

# Course 610121 Automotive Engineering 2

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|---|---|
| Lecturer | Prof. Dr.-Ing. Georg von Tardy-Tuch |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | Vehicle lateral behaviour, powertrain configurations and axle designs<br>• Powertrain configurations for internal combustion engines, hybrid vehicles and electric vehicles<br>• Steering types, Ackermann, tyre behaviour<br>• Aerodynamics, crosswinds and pressure points<br>• Axle stabilisation concepts<br>• Axle configurations |
| Technical expertise: knowledge and understanding | Students learn about the physics of vehicle handling such as toe and camber, as well as<br>their interaction with the vehicle's inertial and aerodynamic behaviour.<br>The standard axle concepts (including steering) are presented<br>with the aspects of vehicle dynamics. |
| Professional competence: skills, knowledge acquisition | The relationship between non-linear mechanical behaviour (axle and tyres) and the dynamic system response of vehicles is highlighted, as are the resulting design trade-offs.<br>Key technical vocabulary in English is introduced as a compulsory part of the course and explained in linguistic terms. |
| Personal competence: social competence | Students deepen their ability to dialogue with the lecturer and fellow students.<br>Foundations from Automotive Engineering 1 are revisited and built upon. |

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| Personal competence: Independence | Through the use of an individual, limited-capacity notepad as the sole aid in the exam, students are indirectly encouraged to summarise the subject matter they have learnt concisely and to structure it in the process. Competencies acquired in other subjects are required to demonstrate the interconnection of the course content. |
| Literature/Learning resources | Haken, *Automotive Engineering*, Hanser-Verlag |

# Module 610210 Mathematics 3

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|---|---|
| Person(s) responsible | Prof. Dr Volker Stahl |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Mathematics 3' module covers fundamental concepts from analytical geometry and the theory of linear differential equations (DGL). Key topics include the Fourier, Laplace and z-transforms, as well as discrete convolution. In addition, systems of linear differential equations are analysed using the eigenvalue method, the matrix exponential function and diagonalisation. Multivariable calculus, gradients and directional derivatives are also covered. |
| Intended learning outcomes | Students will be able to model and solve complex systems using differential equations, in both time-continuous and discrete contexts. They will be able to apply various methods, such as the Laplace transform, the eigenvalue method and diagonalisation, to solve systems of linear differential equations.<br>Furthermore, they can analyse and compute digital filters by using the z-transform. By solving problems in groups and applying the specialist knowledge they have learnt to real-world problems, students demonstrate their ability to work independently and as part of a team. |

# Course 610211 Mathematics 3

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|---|---|
| Course coordinator | Prof. Dr Volker Stahl |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Entry requirements | Prior knowledge from Mathematics 1 and 2. |
| Teaching and learning methods | L/P – Lecture with set assignments |
| Course content | • Fourier transform<br>• Laplace transform<br>• z-transform<br>• Discrete convolution<br>• Impulse response, frequency response, transfer function of discrete systems<br>• Linear differential-equation systems, eigenvalue method, matrix exponential function, diagonalisation<br>• Multivariable calculus, gradient, directional derivatives, tangent plane |
| Subject-specific competence: knowledge and understanding | Students are able to apply the Laplace transform to solve differential equations. They understand the relationship between the Laplace and z-transforms, as well as the relationship between time-continuous and discrete systems. Students understand how to extend differential calculus from single-variable to multi-variable cases and can solve systems of linear differential equations using the Laplace transform, the eigenvalue method and diagonalisation. |
| Subject-specific competence: Skills, knowledge acquisition | Students can model and solve multidimensional systems using differential equations and solve them. They know how to use tools such as the Laplace transform and eigenvalues for this purpose. They can discretise systems and use tools such as the z-transformation to solve them. They |

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| | can apply the z-transform, amongst other things, to calculate the impulse response and transfer function of digital filters. |
| Personal competence: Social competence | Students develop their ability to work in work in groups<br><br>and to solve problems as part of a team. |
| Personal competence: Independence | Students are able to apply the specialist knowledge<br><br>and to deepen their mathematical knowledge independently<br><br>. |
| Literature/Learning resources | • Lecture notes, exercises with model solutions<br><br>• Burg, Haf, Wille: Advanced Mathematics for Engineers, Teubner<br><br>• Papula: Mathematics for Engineers, Springer |

# Module 610220 Modelling and Thermodynamics

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credits | 120 PK |
| Credit award for a combined examination | see course(s) |
| Requirements for participation | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Modelling and Thermodynamics' module covers a range of topics. It begins by teaching the modelling of hydraulic, electrical and mechanical systems, as well as hybrid systems, with the Lagrangian method playing a key role. This is followed by an in-depth study of thermodynamics, including phase transitions, entropy and the second law of thermodynamics. Further topics include processes involving ideal gases, cyclic processes and fluid mechanics, with the continuity equation and Bernoulli's equation playing a key role. |
| Intended learning outcomes | Students will be able to analyse and calculate complex thermodynamic processes, applying the fundamental laws of fluid mechanics and friction. They will be able to calculate ideal gas processes such as compression and expansion, as well as cyclic processes with various configurations. Furthermore, they will be able to calculate sub-processes in systems engineering and use key technical terminology in English correctly. By using a personalised note sheet, they will be able to summarise and structure complex information concisely. |

# Course 610221 Modelling

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| Course coordinator | Prof. Dr.-Ing. Klaus Leimbach |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credit points | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | Modelling of hydraulic, electrical and mechanical systems. Modelling of hybrid mechanical, electrical and hydraulic systems. The Lagrangian method for modelling hybrid systems. |
| Subject-specific competence: knowledge and understanding | |
| Subject-specific competence: Skills, knowledge acquisition | |
| Personal competence: Social competence | |
| Personal competence: Independence | |
| Literature/Learning resources | Scherf, H.E., Modelling and Simulation of Dynamic Systems, Oldenbourg Verlag Föllinger, O., Control Engineering, Hüthig Verlag Heimann, Gerth, Popp, Mechatronics, Fachbuchverlag Leipzig |

# Course 610222 Thermal and Fluid Dynamics

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Hermann Koch-Gröber |
| Frequency of offering | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Entry requirements | Knowledge from 'Engineering Physics' (formerly 'Fundamentals of Thermodynamics'), although there is no formal requirement to have passed this module. |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | In-depth study of thermodynamics and an introduction to fluid mechanics<br>• Phase transitions: evaporation and melting; gas mixtures; moist air<br>• Entropy and the second law of thermodynamics, dissipation<br>• Processes involving ideal gases, isentropic and polytropic processes<br>• Cyclic processes: refrigeration machine/heat pump, power station<br>• The continuity equation and Bernoulli's equation<br>• Viscosity, laminar and turbulent flow, pressure losses |
| Subject-specific competence: knowledge and understanding and | Students are familiar with evaporation melting and the associated changes in state variables. They are familiar with the second law of thermodynamics as a quantification of irreversibility. Processes involving ideal gases, such as compression and expansion, can be calculated. They are familiar with clockwise and anti-clockwise cyclic processes in their common applications.<br>They are familiar with the fundamental equations of fluid mechanics relating to the conservation of mass and energy, as well as the fundamentals of friction. |

| Degree Programme | Professional competence: Skills, knowledge acquisition |
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| | The fundamental principle of systems engineering calculating sub-processes from input to output is explored in greater depth. |

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| | Key technical vocabulary in English is introduced as a compulsory part of the course and explained in linguistic terms. |
| Personal competence: Social competence | Students develop their ability to<br>dialogue with the lecturer and fellow students |
| Personal competence: Independence | Through the use of an<br>individual, limited-capacity<br>notepad as the sole aid in the exam, students are indirectly encouraged to summarise the subject matter they have learnt concisely and to structure it in the process |
| Bibliography/Learning resources | Windisch, Herbert: 'Technical Thermodynamics', Oldenbourg Verlag<br><br>Bohl/Elmendorf: "Engineering Fluid Mechanics", Vogel-Verlag |

# Module 610230 Simulation Technology

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|---|---|
| Responsible person | Prof. Dr.-Ing. Andreas Daberkow |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | Simulation technology is a crucial component of systems engineering for analysing and optimising technical systems such as automotive engineering, robotics and electronics. Students will learn about different types of models and simulation methods in order to create system descriptions and representations. Numerical integration methods enable the visualisation of system behaviour, whilst computer algebra and simulation tools such as MATLAB/Simulink are utilised. Applied examples of linear and non-linear systems enhance the understanding of simulation technology. |
| Intended learning outcomes | Upon completion of the ‘Simulation Technology’ module, students will be able to independently simulate complex technical systems using simulation tools such as MATLAB/Simulink. They will be able to classify mathematical equations for technical systems, create object-oriented data types and visualise simulation results in a scientific manner. Furthermore, they will be able to orient themselves independently and select appropriate solution methods. |

# Course 610231 Simulation Technology

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Andreas Daberkow |
| Frequency of offering | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Entry requirements | Knowledge of electrical engineering and technical mechanics as well as Mathematics 2, but without a formal requirement to have passed |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | Simulation technology as a key element of systems engineering for technical systems (automotive engineering, robotics, electronics).<br>Model types, simulation types, system descriptions, system representations, numerical integration methods,<br>Visualisation, computer algebra, simulation tools, introduction to a simulation tool (Matlab/Simulink).<br>Applied examples of the simulation of linear and non-linear technical systems. |
| Subject-specific competence: knowledge and understanding possibilities of | Students will learn about the simulation technology as a virtual or digital development methodology. They are familiarised with the systematic approach to creating models and implementing them in a simulator. Students are able to independently simulate more complex technical systems using a simulation tool (in this case, MATLAB/Simulink) |
| Subject-specific competence: Skills, knowledge acquisition | Students are able to independently classify mathematical equations for technical systems (automotive engineering, mechatronics) mathematically for subsequent simulation and then implement them in a simulation system. They can create object-based data types for the description of technical systems and visualise simulation results scientifically in 2D and 3D. Students know how to import measurement data sets, transform them mathematically |

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| | transform and visualise them. Students have experience of online examinations. |
| Personal Competence: Social Competence | Students deepen their skills in interacting with lecturers and fellow students. |
| Personal competence: Independence | Students are able to independently the simulation of technical systems and select solution methods. |
| Literature/Learning resources | Lecture notes, exercises with model solutions, video tutorials<br><br>Stein, U. (2023). Programming with MATLAB: A Practical Introduction. 3rd edition. Munich: Hanser.<br><br>Pietruszka, W. (2018). Simulation Technology: Fundamentals, Methods and Tools. 4th edition. Munich: Hanser Verlag.<br><br>Eshkabilov, S. (2022). Beginning MATLAB and Simulink: From Beginner to Pro (2nd ed.). Springer.<br><br>Majumdar, N., & Banerjee, S. (2012). MATLAB Graphics and Data Visualisation Cookbook. Packt Publishing. |

# Module 610240 Signals and Systems

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Frank Tränkle |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Signals and Systems' module covers the fundamentals required for understanding mechatronic systems and control loops. Dynamic systems are analysed using time-continuous models and differential equations. Fourier analysis, the Laplace transform and transfer functions enable the modelling of linear systems. State-space representations of linear and non-linear dynamic systems are also covered. |
| Intended learning outcomes | Upon completion of the 'Signals and Systems' module, students will be able to dynamically model and analyse complex systems in the automotive sector. They will be able to analyse linear models in the frequency domain and draw up signal flow diagrams. Using MATLAB, they will be able to model and design systems both graphically and analytically. Students can independently develop and present solutions, enabling them to effectively analyse and design systems and components in the automotive sector. |

# Course 610241 Signals and Systems

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Frank Tränkle |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Entry requirements | The following prior knowledge is required:<br>• Mathematics 1 and 2<br>• Conservation laws and phenomenological relationships<br>in electrical engineering, classical mechanics and<br>thermodynamics |
| Teaching and learning methods | L/P – Lecture with accompanying practical sessions |
| Course content | • Systems, components in mechatronic systems<br>and control loops<br>• Dynamic, time-continuous system and<br>component models<br>• Differential equations<br>• Deterministic signals<br>• Fourier analysis, Fourier synthesis, Fourier transform<br>• Laplace transform, transfer functions,<br>transfer elements, signal flow diagrams<br>• Frequency responses, amplitude responses, phase responses<br>of linear, time-continuous systems<br>• State-space representations of linear and non-linear<br>dynamic systems |

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| | • Operating-point linearisation<br>• System properties of linear, time-invariant, time-continuous systems<br>• Application of the MATLAB Control System Toolbox |
| Subject-specific competence: knowledge and understanding | Students will be able to<br>• describe systems and components in the automotive sector using dynamic, time-continuous models<br>• analyse and linearise these models in the time domain<br>• analyse linear, time-invariant models in the frequency domain analyse<br>• Describe systems using signal flow graphs and transfer functions |
| Subject-specific competence: skills, knowledge acquisition | Students are able to apply the methods analytically, graphically and using the MATLAB Control System Toolbox.<br>They can use these methods to analyse and design systems and components in the automotive sector. |
| Personal competence: Social competence | Students should apply the knowledge and methods in study groups outside the course and consolidate them. |
| Personal competence: Independence | Students are able to work independently and take responsibility for applying the knowledge and methods, devising solutions and presenting them. |
| Literature/Learning resources | • Frank Tränkle: Signals and Systems, Lecture notes, Heilbronn University of Applied Sciences, 2025<br>• Jan Lunze: Control Engineering 1, Springer Vieweg, 2020 |

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| | • Gerd Schulz, Klemens Graf: Control Engineering 1, De<br><br>Gruyter Studium, 2015 |

# Module 610250 System Dynamics

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| Person(s) responsible | Prof. Dr.-Ing. Georg von Tardy-Tuch |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Dynamics of Systems' module covers kinematic and kinetic methods for describing and analysing systems comprising rigid bodies. Global and local coordinates, as well as lower and higher-order constraints, are systematically determined in order to identify the degrees of freedom of systems.<br>Rotation matrices are an important component of the kinematic description. Kinetically, the system behaviour is modelled using the free-section method and Newton's or Euler's equations of motion. Furthermore, approaches to the numerical treatment of multi-body systems, such as the total differential method and Newton's method, are presented. |
| Intended learning outcomes | Students will be able to analyse and describe complex mechanical systems dynamically. They will be able to formulate equations of motion and decompose systems into coupled sub-problems. Furthermore, they will be able to formulate system descriptions for numerical solutions and convert real-world systems into multidimensional differential equations. This enables the effective analysis and simulation of mechanical systems, thereby equipping students to develop and present solutions independently. |

# Course 610251 Dynamics of Systems

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Georg von Tardy-Tuch |
| Frequency of offering | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Entry requirements | The following prior knowledge is required:<br>• Mathematics 1 and 2<br>• Technical Mechanics 1 and 2 |
| Teaching and learning methods | L/P – Lecture with accompanying exercises |
| Course content | Kinematic description of a system of rigid bodies<br>• Global and local coordinates, stationary and moving observers<br>• Simple and complex bearings<br>• Systematic determination of the degrees of freedom of systems<br>• Rotation matrices<br>Kinetic determination of system behaviour<br>• Free-cut<br>• Newtonian and Eulerian equations of motion<br>Approaches to the numerical treatment of multi-body systems<br>• Total differential<br>• Newton's method |
| Subject-specific competence: knowledge and understanding | Students will be able to<br>• describe systems in terms of their kinematics<br>• formulate the dynamic equations of motion<br>• decompose the system into coupled sub-problems |

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| | • create system descriptions for numerical analysis |
| Subject-specific competence: skills, knowledge acquisition | Students can analyse real mechanical systems into multidimensional differential equations for numerical solution. In addition to kinematic/kinetic formulations, energy-based methods are also covered. |
| Personal competence: social skills | Students should apply the knowledge and methods in<br>study groups outside the course and<br>consolidate them. They learn to develop different approaches to solving problems<br>and are thus provided with methods for self-assessment<br>. |
| Personal competence: Independence | Students are able to work independently and take responsibility for applying their knowledge and methods, devising solutions and presenting them.<br>In doing so, they learn to assess their own work by utilising different approaches. |
| Literature/Learning resources | • Lecture notes, Heilbronn University of Applied Sciences, 2025<br>• Gross & Hauger: Technical Mechanics 3, Springer<br>• Russel Hibbeler: Engineering Mechanics 3, Addison Wesley<br>• Dankert: Engineering Mechanics, Springer |

# Module 610260 Measurement Technology and Sensor Technology

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|---|---|
| Person(s) responsible | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment in the case of a combined examination | See course(s) |
| Entry requirements | See course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The course content of the 'Measurement Technology and Sensors' module covers the fundamentals of measurement technology, including measurement systems, electrical measurement technology, operational amplifiers and oscilloscopes. In addition, topics such as sampling, analogue-to-digital conversion, digital-to-analogue conversion, sensor technology and its applications in the automotive sector. Furthermore, the concept of ADAS (Advanced Driver Assistance Systems) and the sensor technology required for it are explained. |
| Intended learning outcomes | Upon completion of the 'Measurement Technology and Sensor Technology' module, students will be able to tackle and resolve measurement-related tasks in their professional engineering practice. They will have a comprehensive understanding of measurement technology and will be able to discuss engineering issues with colleagues in the field. Through in-depth practical exercises, they will be able to analyse and solve complex problems. |

# Course 610261 Measurement Technology and Sensor Technology

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | - |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content | • Measurement systems, structures of measuring equipment<br>• Electrical measurement technology (measurement of voltage, current, power, ohmic resistance, bridge circuits, impedances)<br>• Operational amplifiers in measurement technology<br>• Measuring with an oscilloscope (principles of operation, operation, modes, necessity and operation of a passive probe)<br>• Sampling, analogue-to-digital conversion, digital-to-analogue conversion<br>• Sensor technology, general: fundamentals, measurement of geometric quantities, measurement of mechanical quantities, measurement of fluidic quantities, temperature measurement<br>• Sensors and measurement technology in motor vehicles: driver assistance systems, active and passive safety systems, principles of operation and sensor technology for ABS, ASR, ESP<br>• ADAS: overview, operating principles, required sensor technology<br>•Overview / Outlook: Automated driving (SAE levels, objectives, challenges in designing a sensor setup, future trends) |
| Subject-specific competence: Knowledge and understanding of | Students learn about the possibilities measurement technology and become familiar with the most important measurement methods for physical quantities in the automotive sector. |

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| Professional competence: Skills, knowledge acquisition | Students explore the methodological approach to measurement technology in engineering disciplines, so that they can apply it in their professional practice as engineers. |
| Personal competence: Social competence | Students work on metrological tasks in small groups and are able to discuss engineering issues with fellow students. |
| Personal competence: Independence | The lecture content is further explored practical exercises. Students are able to contextualise, identify, formulate and solve problems raised in the lectures. |
| Bibliography/Learning resources | • Elmar Schrüfer, Leonhard M. Reindl, Bernhard Zagar: Electrical Measurement Technology: Measurement of Electrical and Non-Electrical Quantities, 11th edition, Hanser, 2014.<br>• Rainer Parthier: Measurement Technology, 8th edition, Springer, 2016.<br>• Konrad Reif: Sensors in Motor Vehicles, 2nd edition, Springer 2012.<br>• Winner et al.: Handbook of Driver Assistance Systems, 3rd edition, Springer, 2015. |

# Module 610270 Control Engineering

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| Course Coordinator | Prof. Dr.-Ing. Frank Tränkle |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Control Engineering' module focuses on the analysis of control loops in linear, time-invariant SISO systems. It covers the selection of suitable controller types for different controlled systems, as well as the analysis of stability and robustness in the closed-loop system. In addition, controller design methods such as frequency response analysis and frequency optimisation, as well as extensions of the single-loop control system, such as cascade control and feedforward control. Furthermore, state-space controllers, root locus methods and pole placement are presented, with application examples from the automotive sector and the use of the MATLAB Control System Toolbox are discussed. |
| Intended learning outcomes | Upon completion of the 'Control Engineering' module, students will be able to design and implement linear controllers in the automotive sector, as well as analyse control loops in the time and frequency domains. They will be able to apply the methods analytically, graphically and using the MATLAB Control System Toolbox, and to develop and present them. |

# Course 610271 Control Engineering

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|---|---|
| Lecturer | Prof. Dr.-Ing. Frank Tränkle |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisites for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Entry requirements | The following prior knowledge is required:<br>• Signals and Systems<br>• Mathematics 3 |
| Teaching and learning methods | L/P – Lecture with accompanying exercises |
| Course content | • Single-loop control loops for linear time-invariant SISO<br>systems (single-input, single-output)<br>• Selection of controller types for various<br>controlled systems<br>• Stability and robustness in the closed-loop system<br>• Controller design using frequency response<br>methods, symmetric optimum, magnitude optimum<br>• Extensions of the single-loop control system:<br>cascade control, disturbance feedforward,<br>feedforward control<br>• Differential equations, z-transform, discrete-time<br>Controllers<br>• State-variable controllers<br>• Root locus method, pole specification<br>• Application examples from the automotive sector<br>• Application of the MATLAB® Control System Toolbox |

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| Subject-specific competence: knowledge and understanding | Students will be able to<br>• design and implement linear controllers in the automotive sector<br>implement them,<br>• and, based on a system analysis of the controlled systems,<br>select suitable controller types<br>• and, based on system requirements,<br>parameterise the controllers<br>• extend the controllers in accordance with the requirements by<br>additional transfer elements,<br>• analyse control loops in the time and frequency domains<br>,<br>• design discrete-time controllers for<br>implementation as embedded software. |
| Professional competence: Skills, knowledge acquisition | Students are able to apply the methods analytically,<br>graphically and using the MATLAB Control System Toolbox.<br>They can use these methods to analyse and design systems and components in the automotive sector. |
| Personal skills: Social skills | Students should acquire the knowledge and methods in<br>study groups outside the course and<br>consolidate them. |
| Personal competence: Independence | Students are able to work independently and take responsibility for applying the knowledge and methods, devising solutions and presenting them. |
| Bibliography/Learning resources | • Frank Tränkle: Control Engineering,<br>Lecture notes, Heilbronn University of Applied Sciences, 2025<br>• Frank Tränkle: Signals and Systems,<br>Lecture notes, Heilbronn University of Applied Sciences, 2025 |

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| | • Jan Lunze: Control Engineering 1, Springer Vieweg, 2020<br><br>• Gerd Schulz, Klemens Graf: Control Engineering 1, De<br><br>Gruyter Studium, 2015<br><br>• Gerd Schulz, Klemens Graf: Control Engineering 2,<br><br>Oldenbourg Wissenschaftsverlag, 2013 |

# Module 610280 Control Engineering Laboratory

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| Person(s) in charge | Prof. Dr.-Ing. Frank Tränkle |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | SL |
| Proof of achievement in a combined examination | see course(s) |
| Requirements for participation | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Control Systems Laboratory' module covers the fundamentals of control theory for linear, time-invariant SISO systems. It covers controller types for various controlled systems, stability and robustness in closed-loop control, controller design using frequency response methods, and extensions of the single-loop control system such as cascade control and disturbance feedback. State-space controllers, the root locus method and pole placement are then introduced. The use of the MATLAB Control System Toolbox and MATLAB/Simulink is also an important part of the module. |
| Intended learning outcomes | Upon completion of the 'Control Engineering Laboratory' module, students will be able to design, implement and analyse complex control systems in the automotive sector. They will be able to select controller types, define controller parameters and extend transfer functions. Furthermore, they will be able to develop discrete-time controllers for embedded<br>software and work in teams to develop solutions for complex problems. Through working on laboratory projects, they are able to work independently and take personal responsibility, and document their results in a manner suitable for presentation<br>. |

# Course 610281 Control Engineering Laboratory

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| Course Coordinator | Prof. Dr.-Ing. Frank Tränkle |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisites for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Entry requirements | The 'Signals and Systems' module must be passed as a<br>compulsory<br>requirement.<br><br>The following prior knowledge is required:<br>• Signals and Systems<br>• Mathematics 3 |
| Teaching and learning methods | L/S – • independent work on laboratory projects<br>• Independent documentation of laboratory<br>results |
| Course content | Laboratory projects cover a selection of the following topics<br>covered:<br>• single-loop control loops for linear, time-invariant SISO<br>systems (Single-Input-Single-Output)<br>• Selection of controller types for various<br>controlled systems<br>• Stability and robustness in the closed-loop system<br>• Controller design using frequency response<br>methods, symmetric optimum, magnitude optimum<br>• Extensions of the single-loop control system:<br>Cascade control, disturbance feedforward, |

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| | feedforward<br>• Differential equations, z-transform, discrete-time<br>controllers<br>• State-space controllers<br>• Root locus method, pole specification<br>• Application examples from the automotive sector<br>• Application of the MATLAB® Control System Toolbox and<br>MATLAB/Simulink |
| Subject-specific competence: knowledge and understanding | Students will be able to<br>• design and implement linear controllers in the automotive sector<br>implement them,<br>• and, based on the system analysis of controlled systems,<br>select suitable controller types<br>• and, based on system requirements,<br>parameterise the controllers<br>• extend the controllers in accordance with the requirements by<br>additional transfer elements,<br>• analyse control loops in the time and frequency domains<br>,<br>• design discrete-time controllers for<br>implementation as embedded software |
| Professional competence: skills, knowledge acquisition | Students are able to use the knowledge and the<br>methods to develop controllers and analyse control loops. They<br>are able to apply best practices in doing so |
| Personal competence: Social competence | Students develop solutions for complex<br>problems whilst working in a team and can define, implement and |

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| | collaborating teams<br>maintain. |
| Personal competence: Independence | Students are able to carry out laboratory projects work on laboratory projects independently and<br>accountable manner and document the results<br>in a manner suitable for presentation. |
| Literature/Learning resources | • Frank Tränkle: Control Engineering,<br>Lecture notes, Heilbronn University of Applied Sciences, 2025<br>• Frank Tränkle: Signals and Systems,<br>Lecture notes, Heilbronn University of Applied Sciences, 2025<br>• Jan Lunze: Control Engineering 1, Springer Vieweg, 2020<br>• Gerd Schulz, Klemens Graf: Control Engineering 1, De<br>Gruyter Studium, 2015<br>• Gerd Schulz, Klemens Graf: Control Engineering 2,<br>Oldenbourg Wissenschaftsverlag, 2013 |

# Module 610290 Modelling and Simulation Laboratory & Measurement Technology Laboratory

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|---|---|
| Person(s) responsible | Prof. Dr.-Ing. Frank Tränkle |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | SL, SL |
| Assessment in the case of a combined examination | see course(s) |
| Requirements for participation | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The module 'Modelling and Simulation Laboratory & Measurement Technology Laboratory' covers the following topics:<br><br>Modelling and linearising dynamic systems in order to optimise numerical integration methods. In MATLAB/Simulink, state-space models are simulated and analysed. During the laboratory session, tuning rules for numerical Learned integration methods and analysed simulation data in MATLAB. This included projects such as rolling tests to determine the rolling resistance coefficient and the steady-state circular test to determine the self-steering behaviour. |
| Intended learning outcomes | Upon completion of the module 'Laboratory: Modelling and Simulation & Laboratory: Measurement Technology', students will be able to analyse and simulate complex mechatronic systems in order to develop solutions to technical problems. They will be able to create dynamic simulation models, design and implement controllers, and apply measurement and sensor technology using practical examples. Working in teams, they can define, implement and maintain solutions to complex problems, and, working independently, develop and present simulation models. |

# Course 610291 Laboratory: Modelling and Simulation

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| Course coordinator | Prof. Dr.-Ing. Frank Tränkle |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | SL |
| Assessment in the case of a combined examination | |
| Entry requirements | The Simulation Technology module must must<br>.<br>The following prior knowledge is also required:<br>• Signals and Systems<br>• Mathematics 3 |
| Teaching and learning methods | L/S – • independent work on laboratory projects<br>• independent documentation and presentation of the<br>laboratory results |
| Course content | • Modelling of dynamic systems<br>• Linearisation of non-linear state-space models<br>• Tuning rules for numerical integration methods<br>• Modelling and simulation of state-space<br>models in MATLAB/Simulink<br>• Analysis of simulation data in MATLAB<br>• Presentation of laboratory results |
| Subject-specific competence: knowledge and understanding | Students will be able to<br>• design linear controllers for the automotive sector and<br>implement them, |

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| | • and, based on a system analysis of the controlled systems,<br>select suitable controller types<br>• and, based on system requirements,<br>parameterise the controllers<br>• extend the controllers in accordance with the requirements by<br>additional transfer elements,<br>• analyse control loops in the time and frequency domains<br>,<br>• design discrete-time controllers for<br>implementation as embedded software |
| Professional competence: skills, knowledge acquisition | Students are able to use the and the<br>methods to create dynamic simulation models for mechatronic<br>systems and components and carry out simulations<br>. In doing so, they can apply best practices. |
| Personal competence: Social skills | Students develop solutions for complex<br>problems through teamwork and are able to define, implement and<br>collaborating teams, and<br>maintain. |
| Personal competence: Independence | Students can develop simulation models through work independently and on their own initiative, and present the results to the group. |
| Literature/Learning resources | • Uwe Ingelfinger and Frank Tränkle: Laboratory: Modelling and<br>Simulation Technology, manuscript, Heilbronn University,<br>2025 |

# Course 610292 Measurement Technology Laboratory

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| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | SL |
| Assessment in the case of a combined examination | |
| Requirements for participation | - |
| Teaching and learning methods | L/S – Application of previously learnt theoretical principles to practical examples |
| Course content | Examples of projects include:<br>- Introduction to the LabView(R) software<br>• Rolling tests to determine the rolling resistance coefficient<br>• Steady-state circular run to determine self-steering behaviour<br>• Transient circular driving test to determine the yaw angle |
| Subject-specific competence: knowledge and understanding acquired in the lecture | Students apply the knowledge<br>'Measurement and Sensor Technology' through practical examples and specific projects relating to motor vehicles. |
| Professional competence: Skills, knowledge acquisition | Students have access to various vehicles and the corresponding test equipment to draw conclusions about the driving behaviour of the vehicle or its components through various driving tests (chassis alignment, driving dynamics, , noise and emissions measurements) to draw conclusions about the vehicle's handling behaviour or that of its components. |
| Personal competence: Social skills | In small groups, various vehicle projects are carried out, thereby introducing students to an engineering-oriented working environment. |

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| Personal competence: Independence | Each student in the group is responsible for a specific sub-area of the project and must work on it independently. |

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| References/Learning resources | • Adam Zomotor: Chassis Technology, Vehicle Handling, 1st edition, Vogel Fachbuch, 1991.<br>• Winner et al.: Handbook of Driver Assistance Systems, 3rd edition, Springer, 2015. |

# Module 610300 Microcontrollers & Networks

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|---|---|
| Person(s) in charge | Prof. Dr.-Ing. Ansgar Meroth |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 LKBK |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Microcontrollers & Networks' module covers the fundamentals of microcontroller architecture, programming and peripherals. The instruction set and execution, as well as the handling of interrupts, are explained. It also covers the use of sensors via bus systems and, in particular, the physical layer. This part of the module lays the foundations for controlling networks and peripheral devices. |
| Intended learning outcomes | Students will be able to programme and control microcontrollers and networks efficiently. They will be able to describe fundamental problems and apply solution strategies. Through practical exercises and teamwork, they will develop the ability to work independently when solving complex problems. They will be able to communicate using technical terminology and information. |

# Course 610301 Microcontrollers & Networks

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Ansgar Meroth |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisites for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Entry requirements | A basic understanding of digital circuits<br>circuits and programming in the C language |
| Teaching and learning methods | Lecture and exercises – lectures interspersed with case studies and accompanying<br>laboratory exercises |
| Course content | - Microcontroller architectures<br>- Instruction set and execution<br>- Peripherals of a microcontroller<br>- Programming in C and Assembly<br>- Handling interrupts<br>- Controlling sensors via bus systems, particularly at the physical layer |
| Subject-specific competence: knowledge and understanding | Students:<br>- Are familiar with the structure and architectures of microcontrollers and can distinguish them from other architectures<br>-Understand the relationship between architecture and instruction set, and the execution of an instruction in a microcontroller<br>- Are familiar with the peripheral components typically found in microcontrollers<br>-Are familiar with the key aspects of writing programmes in Assembler and C<br>-Know how to configure and programme peripheral components (I/O ports, timers, A/D and D/A converters, interfaces, etc.) |

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| | -Understand the processes involved in handling interrupts and can programme interrupt service routines<br><br>-Understand the strategies for controlling sensors via analogue, digital and serial interfaces and the corresponding hardware (interface, signal conditioning, cables, receivers) and are able to implement simple control systems |
| Professional competence: skills, knowledge acquisition | The aim of the course is to provide a fundamental understanding<br><br>of microcontrollers. Students will acquire the ability to<br><br>describe basic problems and apply the<br><br>apply the corresponding solution mechanisms. |
| Personal competence: social skills | Students work on tasks and selected topics<br><br>in small groups, thereby developing teamwork skills.<br><br>They are able to communicate with their fellow engineering students<br><br>fellow engineering students on a professional level. |
| Personal competence: Independence | The lecture content is supplemented by practical exercises<br><br>. Students are able to<br><br>arising from the lectures, recognise, formulate and solve them. They<br><br>are able to gather, evaluate<br><br>and interpret it independently. |
| Literature/Learning resources | Meroth, Sora: Sensor Networks in Theory and Practice. Springer 2022; lecture slides, videos, links to tutorials and handbooks available on ILIAS |

# Module 610310 Software Engineering

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|---|---|
| Course coordinator | Dr Mihai Kocsis |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | 120 |
| Assessment based on a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Software Engineering' module covers various aspects of software development. In the area of process models, the module covers process modelling, risk management, phase-based process models and agile process models. Requirements are addressed through requirements analysis, stakeholders and objectives, use cases and activity diagrams. This also includes high-level and detailed design using CASE tools and software architecture. |
| Intended learning outcomes resolve complex | Students will be able to methodically analyse and<br><br>software development processes methodically by selecting and applying various process models. They can systematically capture and document requirements, derive suitable design models from them, and design software architectures independently. Furthermore, they utilise modern software development tools and integrate them into the development process to ensure quality assurance and efficient solutions. |

# Course 610311 Software Engineering

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|---|---|
| Course coordinator | Dr Mihai Kocsis |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Entry requirements | Prior knowledge from Computer Science 1 and 2 |
| Teaching and learning methods | L/P – Lecture with accompanying exercises and a project assignment |
| Course content | - Introduction to Linux (Ubuntu)<br>-Project management methodologies (process modelling, risk management, phase-based methodologies, agile methodologies)<br>- Requirements (requirements analysis, stakeholders and objectives, use cases, activity diagrams, requirements and specifications)<br>-High-level design (class and sequence diagrams)<br>-Detailed design (CASE tools, software architecture, views and scenarios, state diagrams)<br>-Design models (software paradigms)<br>-Robotic Operating System (ROS2)<br>-Implementation aspects (complexity, metrics)<br>-Quality assurance (equivalence classes, unit testing)<br>-Version control (SVN, Git)<br>-Deployment (Docker)<br>-Selected chapters (Artificial Intelligence in Software Engineering, Software-Defined Vehicles) |
| Subject-specific competence: knowledge and understanding | Students:<br>1. understand fundamental concepts, principles and methods of software engineering, as well as their role in the software development process, |

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| | 2. are familiar with various software development process models (e.g. waterfall model, V-model, Scrum, DevOps) and can identify their appropriate contexts of application,<br><br>3. understand the fundamentals of requirements analysis, including stakeholder analysis, use cases and specifications,<br><br>4. are familiar with the basic principles of software design as well as common architectural patterns and design principles,<br><br>5. can understand key UML diagram types such as class diagrams, sequence diagrams and state diagrams, and describe their function in the development process,<br><br>6. are familiar with methods and tools for quality assurance (in particular unit testing),<br><br>7. understand the use of version control systems such as Git and their importance in collaborative software projects,<br><br>8. are familiar with the basics of software deployment using containerisation (Docker),<br><br>9. have a basic understanding of current topics in software engineering, such as AI in software engineering and software-defined vehicles. |
| Professional competence: Skills, knowledge acquisition Students: | 1. are able to methodically analyse complex software development processes methodically and to select and apply suitable process models,<br><br>2. can systematically record and document requirements and derive suitable design models from them,<br><br>3. are able to independently design software architectures and model them graphically using UML<br><br>4. use modern software development tools (CASE tools, ROS2, version control systems) and integrate them into the development process,<br><br>5. apply appropriate quality assurance procedures,<br><br>6. use practical problems and case studies to deepen their knowledge and develop it in a way that is relevant to real-world applications. |

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| Personal competence: Social skills | Students acquire the problem-solving skills required to tackle software engineering tasks independently. |
| Personal competence: Independence | Students develop the ability to structure tasks independently and to implement solutions in software engineering on their own initiative. |
| Literature/Learning resources | Handout in the form of presentation slides<br><br>Stephan Kleuker, Introductory Course in Software Engineering with UML<br><br>4th edition<br><br>Schatten, A., Demolsky, M., Winkler, D., Biffl, S., Gostischa-Franta, E.,<br><br>Östreicher, T.: Best Practice Software Engineering<br><br>Schäuffele, J., Zurawka, T.: Automotive Software Engineering<br><br>Linux in 90 Minutes: https://www.ernstlx.com/linux90linux.html<br><br>ROS2 Tutorial: https://docs.ros.org/en/humble/Tutorials.html |

# Module 610320 Introduction to AI

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| Course coordinator | Prof. Dr. rer. nat. Marco Wagner |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | LKBK 90 |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | see course(s) |
| Course content | The 'Introduction to AI' module covers the fundamentals of artificial Intelligence, including its history and definition. A wide range of topics is covered, including knowledge-based systems and evolutionary algorithms in the context of AI. The module also covers the fundamentals of machine learning, with a focus on Python for use in ML and data science, data management, decision trees, clustering, regression and classification. |
| Intended learning outcomes | Upon completion of the "Introduction to AI" module, students will have acquired the following skills:<br><br>They will be able to categorise problems and solution methods into relevant groups and evaluate machine learning methods in order to decide on their application to a given problem. They will understand the basic functioning of machine learning methods and will be able to explain and implement these learning procedures.<br>Furthermore, they will be able to explain the workflow of training, testing and validation, and demonstrate their own skills either in teams or individually. |

# Course 610321 Introduction to AI

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|---|---|
| Course coordinator | Prof. Dr. rer. nat. Marco Wagner |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Module examination |
| Assessment in the case of a combined examination | |
| Entry requirements | |
| Teaching and learning methods | L/P – Lecture with integrated (programming ) exercises:<br><br>- Presentation of theoretical content by the lecturer<br>- Self-directed learning in small groups or individually<br>- Practical programming tasks to consolidate the content<br>- Group discussions and Q&A sessions<br>- Project work in small groups or individually |
| Course content | Introduction to Artificial Intelligence<br>- Terms and definitions<br>- History of AI<br><br>Selected topics in AI, e.g.<br>- Knowledge-based systems<br>- Evolutionary algorithms<br><br>Selected topics in machine learning, e.g.<br>- Using Python for ML and data science<br>- Data in ML<br>- Decision trees & random forests |

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| | - Clustering<br>- Regression<br>- Classification |
| Subject-specific competence: Knowledge and understanding | Students acquire knowledge of the terminology and the currently available approaches in the field of artificial intelligence. They are able to categorise problems and their solution methods into relevant groups. Using various examples, students learn methods of machine learning and carry out sample tasks.<br><br>They distinguish between common branches of AI. Furthermore, they understand the basic functioning of machine learning methods and can explain how these learning processes are carried out.<br><br>Furthermore, students can explain the importance of training, testing and validation within the workflow. |
| Professional competence: Skills, knowledge acquisition | Students learn and understand the fundamentals of artificial intelligence, in particular machine learning. They are able to evaluate different methods in order to decide whether their application is appropriate for a given problem. |
| Personal competence: Social competence | Students work independently, in teams or individually, on selected topics and are able to demonstrate their newly acquired skills in a written examination, a presentation, a written assignment or in a similar manner. |
| Personal competence: Independence | As part of the integrated exercises, students can reflect on their own level of knowledge and adapt their learning processes accordingly. |
| Literature/Learning Resources | Wagner, Marco: Lecture slides; these also include references to further reading |

# Module 610330 Systems Engineering – Management and Accounting

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| Lecturer | Prof. Dr. Ing. Ansgar Meroth |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | LP |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | see course(s) |
| Course content | The module 'Systems Engineering – Management and Accounting' covers the following course content:<br><br>Systems engineering is a method of systems research and development. Management refers to the organisation and control of the system. The principles of systems engineering include the analysis, modelling and simulation of systems. Corporate organisation is divided into structural and procedural organisation. The life cycle of a car illustrates the various phases of development and production. The Product Development Process (PEP) covers fundamental topics such as requirements, engineering change management, configuration management and agile methods. Process models, roles and stakeholders are also an important part of the PEP. In the field of accounting, the distinction between internal and external accounting, the fundamentals of bookkeeping and the preparation of financial statements are taught. |
| Intended learning outcomes | Upon completion of the 'Systems Engineering – Management and Accounting' module, students will be able to analyse and describe complex processes, work as part of a team and make informed contributions. They will understand the fundamentals of bookkeeping, the financial reporting process and the key legal provisions of the German Commercial Code (HGB). Students will be able to record simple business transactions , apply accounting methods and recognise the |

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| | recognise their responsibility for working conscientiously and in compliance with the law. They are able to explore and expand on complex topics independently and can familiarise themselves with new process-related topics. |

# Course 610331 Systems Engineering and Management

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| Course coordinator | Prof. Dr.-Ing. Ansgar Meroth |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | Preparation |
| Entry requirements | Basic programming skills<br>from the modules 'Computer Science 1' and 'Computer Science 2' |
| Teaching and learning methods | Lecture, workshop, assignment, presentation on specific topics. The assignment counts towards the mark |
| Course content | •What is systems engineering?<br>•What is management?<br>•Principles of systems engineering<br>•Business organisation: structural and procedural organisation<br>•The life cycle of a car<br>•Fundamentals of the PEP (Product Development Process) in the automotive industry<br>•Core processes in the PEP, illustrated by a case study on the development of an automotive subsystem: requirements, engineering change management, configuration management, agile methods, testing, system integration, supplier involvement, etc.<br>•Process models in the PEP, roles in the PEP, stakeholder involvement, AI in development, agile methods, |
| Professional competence: knowledge and understanding | Participants will be familiar with the fundamental approaches to systems engineering, organisational structure and process management in the development of system products |
| Professional competence: Skills, knowledge acquisition | Participants will be able to design a sub-process in development based on the principles of systems |

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| | engineering and the relevant literature. |
| Personal competence: interpersonal skills | Participants are able to work in a team to process as part of a team and present their findings accordingly. During the workshop, they will learn to familiarise themselves with a topic quickly within rotating working groups and to make well-informed contributions in plenary sessions. |
| Personal competence: Independence independently with new | Participants are able to familiarise themselves<br><br>process topics. They understand the workflows in industrial companies |
| Literature/Learning resources | • Zurawka, T., Schäuffele, J.: Automotive Software Engineering, Vieweg, Wiesbaden<br><br>• Lecture notes<br><br>• Weber, J.: Automotive Development Processes, Springer, Wiesbaden<br><br>• Alexander Levin et al. Handbook: Automotive SPICE® 4.0 – Fundamentals and Practical Know-how. Hardback – 5 September 2024<br><br>dpunkt.verlag GmbH |

# Event 610332 Accounting

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| Person(s) responsible | Dr Elena Dickert |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Entry requirements | Completion of the foundation stage |
| Teaching and learning methods | L/P – Lecture with integrated exercises |
| Course content accounting | - Distinction between internal and external<br><br>- Fundamentals of bookkeeping (effects of business transactions, posting to balance sheet and profit and loss accounts, chart of accounts, German accounting standards (GoB))<br><br>- Fundamentals of financial statement preparation (balance sheet, profit and loss account)<br><br>- Depreciation<br><br>- Value Added Tax<br><br>- Stock-based accounting (inventory method, carry-forward method)<br><br>- Expense-based accounting |
| Professional competence: knowledge and understanding | Upon completion of the course, students to understand the fundamentals of bookkeeping and the accounting process, and to be familiar with the differences between external and internal accounting. |
| Professional competence: Skills, knowledge acquisition | Students are able to record business transactions and apply various posting methods. Students are able to establish links between bookkeeping, the balance sheet and the profit and loss account. Students are familiar with the key statutory provisions of the German Commercial Code (HGB). |

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| Personal competence: Social competence | Students are able to communicate in a manner appropriate to the subject<br><br>about simple business transactions and their implications. They are aware of<br>of the responsibility and the requirements for |

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| | work conscientiously and in compliance with the law. |
| Personal Competence: Independence | Students are able to independently. |
| Literature/Learning resources | Deitermann, Schmolke et al.: “Industrial Accounting IKR. Financial Accounting, Analysis and Critique of Annual Accounts, Cost and Performance Accounting”; Deitermann, Schmolke et al.: “Industrial Accounting with Cost and Performance Accounting IKR” |

# Module 610340 Studium Generale

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| Person(s) responsible | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Studium Generale' module focuses on understanding the fundamentals of higher education and its role in society. It explores the history of higher education, its significance for individual development and society, as well as the philosophical and ethical aspects of higher education. The modules cover topics such as the fundamentals of education, the role of the individual in higher education, and the relationship between higher education and society. |
| Intended learning outcomes | The Studium Generale equips students to become versatile and strategically minded individuals. By bringing together different disciplines, it fosters a broader general education that enables students to think beyond their own subject area and navigate a dynamic world. Students further develop their personalities and enhance their ability to solve complex problems, which gives them a competitive edge when choosing a future career. |

# Course 610341 Studium Generale

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|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | - |
| Teaching and learning methods | Lecture/Seminar/Practical/Study – See course details in the Studium Generale programme booklet. |
| Course content | See course details in the Studium Generale programme booklet. |
| Subject-specific competence: knowledge and understanding | See course details, Studium Generale programme booklet. |
| Subject-specific competence: skills, knowledge acquisition | The Studium Generale covers a wide a wide variety of content from different disciplines is taught. Students gain insights that extend beyond the scope of their own degree subject. The aim is to acquire additional qualifications |
| Personal competence: social competence | This broadened general education enhances students' ability to think in interconnected and strategic terms. |
| Personal competence: independence | There is an opportunity to personality, improve their general knowledge and gain a competitive edge over others when choosing a future career. |
| Literature/Learning resources | - |

# Module 610350 Practical Study Semester

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|---|---|
| Person(s) responsible | Prof. Dr Volker Stahl |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 30 |
| Total workload (hours) | 750 |
| SWS | 1 |
| Requirements for the award of SR credit points | SA and |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | In the 'Practical Study Semester' module, students will undertake technical tasks in a real-world workplace setting and apply the knowledge and skills they have acquired. This includes preparing a presentation on their project work and analysing the content of fellow students' projects. |
| Intended learning outcomes | The Practical Study Semester prepares students for a successful career by enabling them to gain practical experience in the workplace. By consolidating the knowledge acquired during their studies and linking it to real-world applications, students' understanding of the subject matter is strengthened. Students learn to integrate themselves into workplace processes, conduct independent research, and present and defend their findings. They master fundamental working methods relating to documentation and academic work, as well as the ability to present arguments and discuss complex issues. Following the placement, students are able to present their work and the objectives achieved, and respond competently to queries, which equips them for starting their careers and working independently. |

# Course 610351 Supervised Practical Placement

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| Course coordinator | Prof. Dr Volker Stahl |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 26 |
| Total workload (hours) | 650 |
| SWS | 0 |
| Requirements for the award of credit points | SA |
| Proof of achievement in a combined examination | Internship report, evidence of completion of work placement |
| Requirements for participation | Completion of the foundation stage. |
| Teaching and learning methods | - Practical project work in an industrial company. |
| Course content | In a real-world industrial setting, students undertake technical tasks appropriate to their level of training, applying the knowledge and skills acquired during their studies. |
| Professional competence: knowledge and understanding | Through the , the knowledge acquired during the degree programme is deepened and linked to practical applications, which in turn strengthens the understanding of what has been learnt. |
| Professional competence: Skills, knowledge acquisition | In typical engineering activities, students gain guidance on selecting their elective modules and on project work. Furthermore, the work placement semester facilitates entry into the profession and establishes initial contacts with companies. |
| Personal competence: social skills | Through practical experience, students learn to workplace processes and within teams. |
| Personal competence: Independence | • Independently researching available for work placements<br>• Preparing application documents and attending job interviews<br>• Independently compiling the work placement report |
| Literature/learning resources | |

# Course 610352: Seminars accompanying the practical study semester

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|---|---|
| Person(s) responsible | Prof. Dr Volker Stahl |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 4 |
| Total workload (hours) | 100 |
| SWS | 1 |
| Requirements for the award of credit points | SR |
| Assessment in the case of a combined examination | Presentation at the internship colloquium |
| Requirements for participation | Supervised practical phase completed. |
| Teaching and learning methods | S – Presentations by students, guidance from lecturers. |
| Course content | Preparation of a presentation on one's own project work; content of fellow students' projects. |
| Professional competence: knowledge and understanding | Students are familiar with the fundamentals of documentation<br>and academic work. They know how to present and defend their findings in a clear and comprehensible manner. |
| Professional competence: Skills, knowledge acquisition | Students are familiar with the organisation and sociology of industrial enterprises (staff groups, management levels, potential for conflict). Students have mastered the basic working methods of documentation and academic work. They are able to prepare and deliver a presentation on their practical work, accompanied by a written report. |
| Personal competence: social skills | Complex subject-related problems and solutions are presented and discussed using reasoned arguments. |
| Personal competence: independence | Students are able to present their work and the objectives achieved, and respond competently to queries. |
| Literature/Learning resources | |

# Module 610360 Seminar Paper and Project Management

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|---|---|
| Responsible person | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 10 |
| Total workload (hours) | 250 |
| SWS | 3 |
| Conditions for the award of credit points | LE / LA |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | see course(s) |
| Course content | In the 'Seminar Paper and Project Management' module, students are prepared to plan and carry out their own projects independently. This includes the fundamentals of project organisation, project planning, network analysis, personality and teamwork, as well as risk analysis and quality management. At the same time, the practical project serves as an opportunity to apply this fundamental knowledge. |
| Intended learning outcomes | Upon completion of the 'Seminar Paper and Project Management' module, students will be able to work on and communicate complex tasks independently. They will be able to communicate using technical terminology at a specialist level and to and interpret it independently . Furthermore, they acquire the ability to carry out projects independently and work successfully in teams to develop independent projects. |

# Course 610361 Seminar Paper

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|---|---|
| Lecturer | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 7.5 |
| Total workload (hours) | 187.5 |
| SWS | 1 |
| Requirements for the award of credit points | LE |
| Assessment in the case of a combined examination | |
| Entry requirements | The requirements for sitting module examinations in the main cycle must be met. |
| Teaching and learning methods | L/S – Seminar paper on specific topics |
| Course content | The content will be communicated to students in a topic description for the seminar paper. |
| Subject-specific competence: knowledge and understanding | Students acquire in-depth subject knowledge through practical application in the seminar paper. |
| Subject-specific competence: Skills, knowledge acquisition | Independently identifying a complex task and working through it independently |
| Personal competence: Social competence | Students undertake a task within their field of study and are able to communicate using specialist terminology at a professional level. |
| Personal competence: independence | Students explore a research question from their field of study. They are able to gather, evaluate and independently interpret relevant information. |
| Literature/Learning resources | Scholz, D.: Writing Theses in Accordance with Standards, Vogel, Würzburg, 2006 Esselborn-Krumbiegel, H.: From Idea to Text: A Guide to Academic Writing, UTB Schöningh, Paderborn–Munich–Vienna–Zurich, 2004 |

# Course 610362 Project Management

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|---|---|
| Course coordinator | Ines Marquardt-Schmidt |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | LA |
| Assessment in the case of a combined examination | |
| Requirements for participation | - |
| Teaching and learning methods | L/P – • Lecture on fundamental topics<br>• Team and group coaching / project-specific |
| Course content | Independent planning and implementation of a personal project<br>Fundamentals of the following topics:<br>• Project organisation / Project objectives / Requirements and specifications<br>• Project planning / project structure plan / milestone plan<br>• Network analysis / Resource planning / Budget and schedule planning<br>• Personality / Team / Leadership in projects / Conflict management<br>• Project management / Controlling tools<br>• Project Context / Stakeholder Analysis<br>• Risk analysis / Risk management<br>• Quality management / Documentation / Project closure<br>Simultaneous application of fundamental knowledge to a practical project. |
| Professional competence: knowledge and understanding | Students produce a documented project report (with a theoretical introduction). |
| Professional competence: Skills, knowledge acquisition | Students learn the ability to carry out projects independently. |
| Personal competence: social skills | Students work together as a team to carry out an independent project. |

| | |
|---|---|
| Personal competence: Independence | Within the project, each student is responsible for a separate area within the project. |
| Literature/Learning resources | Lecture notes based on 'Projektmanagementfachmann', Volumes 1+2 (GPM)<br><br>Gessler, M. (ed.): Competence-Based Project Management (PM3): Handbook for Project Work, Qualification and Certification, GPM German Society for Project Management, Nuremberg, 2016<br><br>Schelle, H.: Leading Projects to Success, 7th ed., Beck, Munich<br><br>Felkai, R.; Beiderwieden, A.: Project Management for Technical Projects, Vieweg+Teubner, 2011<br><br>Hemmrich, A.; Harrant, H.: Project Management, Pocket Power, Hanser Verlag, 2016 |

# Module 610370 Specialised Advanced Studies 1

| | |
|---|---|
| Person(s) responsible | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | See the module handbook for the selected course |
| Intended learning outcomes | See the module handbook for the selected course |

# Course 610371 Elective(s) in accordance with section 3.2

| | |
|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | - see the module handbook for the chosen course |
| Course content | see the module handbook for the chosen course |
| Subject-specific competence: knowledge and understanding | See the module description |
| Subject-specific competence: Skills, knowledge acquisition | See the module description |
| Personal competence: social skills | See module description |
| Personal competence: independence | See module description |
| Literature/learning resources | See the module handbook for the chosen course |

# Module 610380 Specialised Studies 2

| | |
|---|---|
| Person in charge | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | See the module handbook for the selected course |
| Intended learning outcomes | See the module handbook for the selected course |

# Course 610381 Elective(s) in accordance with section 3.2

| | |
|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 2.5 |
| Total workload (hours) | 62.5 |
| SWS | 2 |
| Prerequisite for the award of examination credits | module |
| Assessment for combined examinations | |
| Requirements for participation | |
| Teaching and learning methods | - see the module handbook for the chosen course |
| Course content | see the module handbook for the chosen course |
| Subject-specific competence: knowledge and understanding | See the module description |
| Subject-specific competence: Skills, knowledge acquisition | See the module description |
| Personal competence: social skills | See module description |
| Personal competence: independence | See module description |
| Literature/learning resources | See the module handbook for the chosen course |

# Module 610390 Specialised Studies 3

| | |
|---|---|
| Person in charge | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | See the module handbook for the selected course |
| Intended learning outcomes | See the module handbook for the selected course |

# Course 610391 Elective(s) in accordance with section 3.2

| | |
|---|---|
| Person(s) responsible | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | - see the module handbook for the chosen course |
| Course content | see the module handbook for the chosen course |
| Subject-specific competence: knowledge and understanding | See the module description |
| Subject-specific competence: Skills, knowledge acquisition | See the module description |
| Personal competence: social skills | See module description |
| Personal competence: independence | See module description |
| Literature/learning resources | See the module handbook for the chosen course |

# Module 610400 Specialised Studies 4

| | |
|---|---|
| Person in charge | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | See the module handbook for the selected course |
| Intended learning outcomes | See the module handbook for the selected course |

# Course 610401 Elective(s) in accordance with section 3.2

| | |
|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | - see the module handbook for the chosen course |
| Course content | See the module handbook for the chosen course |
| Subject-specific competence: knowledge and understanding | See the module description |
| Subject-specific competence: skills, knowledge acquisition | See the module description |
| Personal competence: social skills | See module description |
| Personal competence: independence | See module description |
| Literature/learning resources | See the module handbook for the chosen course |

# Module 610410 Specialised Studies 5

| | |
|---|---|
| Person in charge | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | See the module handbook for the selected course |
| Intended learning outcomes | See the module handbook for the selected course |

# Course 610411 Elective(s) in accordance with section 3.2

| | |
|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credit points | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | - see the module handbook for the chosen course |
| Course content | see the module handbook for the chosen course |
| Subject-specific competence: knowledge and understanding | See the module description |
| Subject-specific competence: Skills, knowledge acquisition | See the module description |
| Personal competence: social skills | See module description |
| Personal competence: independence | See module description |
| Literature/learning resources | See the module handbook for the chosen course |

# Module 610420 Specialised Studies 6

| | |
|---|---|
| Person in charge | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Requirements for the award of credit points | Lx |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | See the module handbook for the selected course |
| Intended learning outcomes | See the module handbook for the selected course |

# Course 610421 Elective(s) in accordance with section 3.2

| | |
|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency of the course | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 5 |
| Total workload (hours) | 125 |
| SWS | 4 |
| Prerequisite for the award of examination credits | module |
| Assessment in the case of a combined examination | |
| Requirements for participation | |
| Teaching and learning methods | - see the module handbook for the chosen course |
| Course content | see the module handbook for the chosen course |
| Subject-specific competence: knowledge and understanding | See the module description |
| Subject-specific competence: Skills, knowledge acquisition | See the module description |
| Personal competence: social skills | See module description |
| Personal competence: independence | See module description |
| Literature/learning resources | See the module handbook for the chosen course |

# Module 610430 Bachelor's Thesis / Project

| | |
|---|---|
| Person(s) responsible | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 15 |
| Total workload (hours) | 375 |
| SWS | 0 |
| Requirements for the award of credit points | PB, PA, PA |
| Assessment in the case of a combined examination | see course(s) |
| Entry requirements | see course(s) |
| Teaching and learning methods | See course(s) |
| Course content | The 'Bachelor's Thesis / Project' module focuses on scientific problem-solving under the supervision of a professor. The objectives and scope of the engineering problem are defined, followed by the establishment of a methodological approach. Literature research, a review of the state of the art and independent work on the problem are crucial. Documentation of the results, discussion, conclusions and a summary are also required. Preliminary work for project planning includes drawing up a timetable, researching the state of the art and identifying the relevant literature. |
| Intended learning outcomes | The Bachelor's Thesis and Project module enables students to tackle complex technical problems methodically and develop solutions. They are able to plan, carry out and reflect on specific projects independently, whilst deepening their specialist knowledge and presenting their findings to subject experts. Students learn to evaluate projects, discuss issues with colleagues and work on technical tasks. |

# Course 610431 Bachelor's Thesis / Project

| | |
|---|---|
| Course Coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 12 |
| Total workload (hours) | 300 |
| SWS | 0 |
| Requirements for the award of credit points | PB |
| Assessment in a combined examination | Completion of the foundation stage and successful completion of the practical study semester. |
| Requirements for participation | Completion of the foundation stage and successful participation in the practical study semester. |
| Teaching and learning methods | - A written dissertation under the guidance and support of supervising professors or (as a co-supervisor) suitable individuals from companies, institutions, etc. The Bachelor's dissertation is produced by the students as an independent project. |
| Course content | Scientific problem-solving under the supervision of a professor:<br>• Defining the objectives and scope of the engineering problem<br>• Explanation of the methodological approach<br>• Literature review<br>• State of the art<br>• Independent work on the task<br>• Documentation of the results<br>• Discussion, conclusions<br>• Summary |
| Professional competence: knowledge and understanding | Ability to tackle a technical problem using scientific methods and to document the results. |
| Professional competence: Skills, knowledge acquisition | The student is able to methodically tackle a specific task from the subject area methodically as a development or calculation project. |
| Personal competence: Social competence | Students deepen their specialist knowledge and work independently. They learn to present complex results and |

| | |
|---|---|
| | correlations to subject matter experts and to develop them further. |
| Personal competence: Independence | Students take independent responsibility for planning, carrying out and reflecting on the project content. |
| Bibliography/Learning resources | Scholz, D.: Writing Theses in Accordance with Standards, Vogel, Würzburg, 2006 Esselborn-Krumbiegel, H.: From Idea to Text. A Guide to Academic Writing, UTB Schöningh, Paderborn–Munich–Vienna–Zurich, 2004 Winter, W.: Writing Academic Papers, Redline Wortschaft bei Überreuter, Frankfurt–Vienna, 2004 Rechenberg, P.: Technical Writing (Not Only) for Computer Scientists, Hanser, Munich, 2003 Kropp, W./Huber, A.: Interactive Student Research Projects. A Guide – multimedia-compact – e-learning programme, TeamMediaVerlag, 2006 |

# Course 610432 Project Planning and Colloquium

| | |
|---|---|
| Course coordinator | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 3 |
| Total workload (hours) | 75 |
| SWS | 0 |
| Requirements for the award of<br><br>A credit points | P |
| Assessment in a combined examination | Completion of the foundation stage and successful completion of the practical study semester. |
| Requirements for participation | Completion of the foundation stage and successful participation in the practical study semester. |
| Teaching and learning methods | S – Learning by doing under the guidance of a supervising professor |
| Course content | All necessary preparatory work for project planning, such as:<br>• drawing up a timetable<br>• Research into the state of the art<br>• Identifying relevant literature<br>• Searching for resources such as commercially available semi-finished products, measuring instruments, software or external expert knowledge<br>• preparatory documentation on the solution tools and the fundamentals of the specific technology |
| Professional competence: knowledge and understanding | Students are able to methodically undertake specific (software<br><br>) development, design and calculation projects in a methodical manner. |
| Professional competence: skills, knowledge acquisition | Students learn to assess the complexity of projects in advance. Through working on and evaluating projects, their planning experience gradually increases. |
| Personal competence: Social competence | Students tackle technical tasks as projects and are able to discuss issues with fellow specialists. |
| Personal competence: Independence | See module description |
| Literature/Learning resources | See module description |

# Course 610432 Project Planning and Colloquium

| | |
|---|---|
| Lecturer | Prof. Dr.-Ing. Nicolaj Stache |
| Frequency | Every semester |
| Duration of the module (semesters) | 1 |
| Credit points (ECTS) | 3 |
| Total workload (hours) | 75 |
| SWS | 0 |
| Requirements for the award of credit points | PA |
| Assessment in the case of a combined examination | |
| Entry requirements | see module description |
| Teaching and learning methods | S – Learning by doing under the guidance of a supervising professor |
| Course content | All necessary preparatory work for project planning, such as:<br>• drawing up a timetable<br>• Research into the state of the art<br>• Identifying relevant literature<br>• Searching for resources such as commercially available semi-finished products, measuring instruments, software or external expert knowledge<br>• preparatory documentation on the solution tools and the fundamentals of the specific technology |
| Professional competence: knowledge and understanding | Students are able to methodically undertake specific (software<br>) development, design and calculation projects in a methodical manner. |
| Professional competence: skills, knowledge acquisition | Students learn to assess the complexity of projects in advance. Their planning experience gradually increases through working on and evaluating projects. |
| Personal competence: Social competence | Students tackle technical tasks as projects and are able to discuss issues with fellow students. |
| Personal competence: Independence | see module description |
| Literature/Learning resources | see module description |

# Specialisation tracks in ASE

Section 3.2 of the examination regulations for the ASE-B degree programme governs the selection of optional modules and the associated choice of specialisations. The specialisations currently on offer are described below. *Table 1* shows which modules can be credited towards the respective specialisation and which modules are recommended as supplementary. Descriptions of these subjects can be found in the document
'Elective subject catalogues and module descriptions for the Bachelor's degree programmes of the Faculty of Engineering' on the Faculty of Engineering's website.

## Specialisation in Drive Systems

In the 'Drive Systems' specialisation, the fundamental knowledge acquired to date is applied in depth to the challenges posed by modern automotive drive systems. The modules cover, in theory and practice, typical design elements, electrical machines and internal combustion engines. Topics include the operation of battery-electric vehicles, the
Engine management to minimise emissions and fuel consumption in internal combustion engines, as well as operating strategies for hybrid vehicles. In the associated laboratory sessions, students learn how to use professional simulation software for powertrain systems.

## Specialisation in Automotive Software

In the 'Automotive Software' specialisation, the fundamental knowledge acquired during the degree programme is extended to cover the design of software-defined systems. The
focus covers various architectural levels, ranging from hardware design, through the development of real-time operating systems on microcomputers (embedded systems), via ISO/OSI layers 2–4 communication protocols and architectures (distributed systems), to
image processing and human-computer interaction (where a user interface is designed using a model-based approach). The 'Model-Based Software Engineering' module covers model-driven embedded software development for automotive control systems and
robotics applications based on simulation models in MATLAB/Simulink, C++ or Python. In the Electronic Systems project laboratory, students design a control unit with hardware and software, which is tested in one of our laboratory vehicles, or contribute in other ways to the software-intensive development of vehicle functions. The module
'Safety Systems' focuses on software safety in the automotive context.

## Electromobility specialisation

Since 2010, Heilbronn University has been committed to electromobility and operates a battery-electric research and teaching vehicle. The university is a member of the South-West Electromobility Cluster and a founding member of the Heilbronn-Franken Electromobility Association (EHF). The following selection is recommended if you are interested in
electric mobility and wish to tailor your specialisation accordingly.

## Specialisation in Electronic Systems

Electronic systems in motor vehicles consist of control units, their networking, and the associated sensors and actuators. The 'Electronic Systems' specialisation builds on the fundamentals of electronic
circuit design and microcontroller technology to cover complete systems. The interaction between hardware and software in the control units is covered in the lectures
'Circuit Development' and 'Embedded Systems in Motor Vehicles'. The lecture
'Distributed Systems', the requirements for the bus systems used in motor vehicles are discussed and the knowledge acquired is applied to the networking of a sensor. In the module 'Project Laboratory – Electronic Systems', students learn how to plan and carry out projects. The development of modern systems is not possible without the use of simulations. These are covered in the module 'Model-Based Software Development'. To ensure that electronic systems in motor vehicles function reliably and do not interfere with one another, compliance with 'electromagnetic compatibility' is required; the
fundamentals are presented in the 'EMC' lecture.

## Specialisation: International Aspects of Automotive Systems

This specialisation is aimed in particular at students who wish to pursue a career characterised by international collaboration and partnerships. You may enrol in this specialisation if you have earned a minimum of 15 and a maximum of 20 credits at one of our numerous partner universities; where possible, and following consultation with our partner university coordinators, these credits should be related to ASE. At present, this is particularly possible in Coventry (UK) and Indianapolis (USA). We have further partners in Egypt, China, France, Georgia, the UK, Cuba, Jordan, Latvia, Slovenia, Spain, South Africa, South Korea, Taiwan and other countries. Additional subjects (e.g. languages) can, of course, also be taken whilst abroad. By completing this specialisation, you demonstrate that you are able to navigate a foreign culture abroad and
achievements. During your one-semester stay, you will get to know the host country in depth. Up to 20 ECTS from any technical subjects at the partner university can be recognised as electives. You can earn further credits if you take subjects at the partner university that are equivalent to our compulsory subjects and which you have not yet completed in Heilbronn. If you do not bring back 20 ECTS from abroad, the remaining elective modules must be taken from the ASE programme, with at least 5 ECTS of these being taught in English (e.g. Human-Machine Interface, Powertrain, Multi-Body Simulation).

## Specialisation in Mechanical Systems

In the 'Mechanical Systems' specialisation, the
mechanical fundamentals acquired to date are explored in greater depth. Automotive systems often consist of several interconnected bodies that also move in space. Another task is the propulsion of the vehicle

itself. The modules cover, on the one hand, the theory and application of spatial mechanics under constraints and, on the other hand, typical
design elements and the management of drive systems in motor vehicles. In the associated laboratory sessions, students learn how to use professional simulation software for
propulsion systems and rigid-body systems, which is then applied in practical examples.

*Table 1: Specialisation tracks and elective modules for ASE-B*

| Specialisation ASE-B | | | | | | General information | | | Scope | Course details | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Propulsion Systems | Automotive Software | Electric Mobility | Electronic Systems | International Aspects of Automotive Systems | Mechanical Systems | Module number | Course title | Type | ECTS | Recommended from semester | Language of instruction |
| x | | | | * | x | 610701 | Powertrain | V/Ü | 5 | 6 | English |
| | x | | | * | | 609321 | Computer Vision | V/L | 5 | 6 | English |
| | x | | | * | | 605704 | Computer graphics | V/Ü | 5 | 6 | German / English |
| x | | x | | * | | 610702 | Electric drive systems and actuators in motor vehicles | V/Ü | 5 | 3 | German |
| o | | x | o | * | | 610703 | Electric Mobility Systems | V/Ü | 2.5 | 7 | German |
| | | o | | * | | 610704 | Electric Mobility and Energy Management | V/Ü | 2 | 7 | German |
| | x | x | x | * | | 610705 | Embedded Systems in the Automotive Industry | V/Ü | 5 | 6 | English |
| | | | x | * | | 610706 | EMC | V/Ü | 2.5 | 6 | German |
| o | o | x | o | * | | 610707 | Energy management | V/Ü | 2.5 | 6 | German |
| x | | | | * | o | 610708 | Driving dynamics | V/Ü | 2.5 | 6 | German |
| | | o | | * | | 607705 | Fundamentals of Fibre-Reinforced Composites | V/Ü | 2.5 | 7 | German |
| y | y | y | y | * | y | 610041 | Fundamentals of Measurement Technology | V/Ü | 2.5 | 2 | German |
| y | y | y | y | * | y | 610121 | Automotive Technology 1+2 | V/Ü | 5 | 2 | German |
| | | | | * | x | 610709 | Components in the chassis system | V/Ü | 5 | 4 | German |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| x | | | | * | x | 610710 | Automotive design components | V/Ü | 5 | 3 | German |
| | | x | o | * | | 605709 | Power electronics | V/Ü | 5 | 4 | German |
| | | | | * | x | 610711 | Multi-body simulation | V/Ü | 5 | 6 | German / English |
| | o | | o | * | | 610712 | MMI | V/Ü | 2.5 | 3 | English |
| | x | | x | * | o | 610713 | Model-based Software Engineering | V/Ü | 5 | 6 | English |
| x | | | | * | x | 610714 | Project Laboratory – Powertrain | L/S | 2.5 | 6 | German / English |
| | x | | x | * | | 610715 | Project Lab – Electronic Systems | L/S | 5 | 6 | German / English |
| x | | | | * | x | 610716 | Project Laboratory – Multi-body Simulation | L/S | 2.5 | 6 | German / English |
| | | o | | * | | 606716 | Renewable Energy | V/Ü | 2.5 | 4 | German / English |
| | o | o | x | * | | 610717 | Circuit design | V/Ü | 5 | 3 | German |
| o | x | o | o | * | o | 610718 | Control and Regulation Systems | V/Ü | 2.5 | 6 | German |
| o | | x | | * | | 610719 | Systemic testing of battery cells | V/Ü | 2.5 | 4 | German |
| o | | | | * | | 612715 | Internal combustion engines | V/Ü | 5 | 4 | English |
| o | x | o | x | * | | 610720 | Distributed Systems in Motor Vehicles | V/Ü | 5 | 4 | German |
| o | | | | * | | 606721 | Hydrogen technology | V/Ü | 2.5 | 4 | German / English |
| o | o | o | o | * | o | 610721 | Field study | L/S | 2.5 | 5 | English |
| o | o | o | o | * | o | 610722 | International Project Work | L/S | 2.5 | 5 | English |

**Key:**

x : Core catalogue for the specialisation. According to the Study Regulations (SPO), at least 20 ECTS must be completed from this catalogue in order for the specialisation to be recognised

o : This module is an optional addition to the specialisation. The ECTS credits for this module do *not* count towards the total required for the specialisation to be recognised.

y: This module can only be taken as an elective in conjunction with the English-language foundation programme.

* : The following criteria must be met for the 'International Aspects of Automotive Systems' specialisation to be recognised:

- Completion of 15 ECTS from modules at a foreign university (15 ECTS),
- Completion of a further 5 ECTS from modules at a foreign university or from an English-taught module within the ASE programme (5 ECTS)