Faculty of Automotive Systems and Production

Module Catalog
Vehicle Development

Bachelor of Engineering (B.Eng.)

Technology
Arts Sciences
TH Köln

Contents

Module Catalog | Vehicle Development, Bachelor of Engineering

1 Program Description

The automotive industry is by far the most important industrial sector in Germany. In 2020, around 800,000 employees generated revenues of around €380 billion in this sector. Even in an international comparison, Germany is still one of the most important locations for the vehicle industry, with an export value of over €180 billion[1].

The value chain in the automotive industry is highly differentiated. In addition to the major automotive manufacturers, the industry also includes countless national and international suppliers. Even industries that at first glance have little to do with vehicle manufacturing are involved in the development and production of vehicles and vehicle parts and benefit directly from automotive manufacturing. A key factor in the success of German car manufacturers is their innovative strength. Global spending on research and development was nearly €45 billion in 2018, once again reaching the highest share in the German economy [2].

At the same time, the automotive industry is experiencing an epochal upheaval that will seriously and sustainably change the working conditions in vehicle manufacturing in the coming years. On the one hand, this involves the necessary ecological restructuring of products, which means: from fossil drive concepts towards electric units and corresponding energy storage systems. On the other hand, the need to use digital solutions will increase sharply.

Nowhere else is it of such existential necessity to orient the training of graduates in such a way that they can offer a tailored response to the new challenges. The future engineers of the degree program can therefore expect highly interesting and varied tasks in the industry. They have the chance to change products so that they meet the new requirements and create real added value for society.

In this context, the Bachelor's degree program in Vehicle Development is a first degree that qualifies students for a profession and at the same time prepares them for a possible following Master's degree program in the field of vehicle development. In a variety of internships and group-oriented projects, the degree program conveys in an application-oriented manner the contents that are necessary to competently deal with the challenges described above in the intended professional field. The aim is to develop a profound overall understanding of the technical system of the *automobile* and, at the same time, to acquire the necessary depth in certain sub-areas that is required to solve detailed technical problems.

To this end, the degree program imparts the tools and methods needed to create competitive, innovative and sustainable vehicles. Especially against the background of the enormous speed of change in the target industry, a project-centered and competency-based degree program is an enormously important tool for meeting professional requirements.

The curriculum of the Bachelor's degree program in Vehicle Development consists of three phases, each building on the other:

- *Fundamentals of engineering (1st and 2nd semester)*
  Relevant engineering and scientific fundamentals are taught, similar to those provided in

[1] destatis.de, code: 42111-0003, Federal Statistical Office, 2021

[2] Automotive industry, bmwi.de, Federal Ministry for Economic Affairs and Energy, 2021

any other engineering degree program. The vehicle-independent teaching is intended to be the basis for further specific specializations in the field of automotive engineering.

- *Specialization phase (3rd to 5th semester)*
  At the beginning of the specialization phase, students decide on a field of study in order to further develop their desired skills and competencies in a targeted manner. It is possible to choose *Automotive Engineering* with classic mechanical engineering content, or the *Digital Vehicle*field of study to deal with the necessary adaptations in the digital area.
- *Practical and final phase (6th and 7th semester)*
  In the third phase, students learn how to put their knowledge into practice in an entrepreneurial environment during a practical semester. In addition to the Bachelor thesis, interdisciplinary qualifications are also increased in this phase.

In both specializations, individual digitization skills are expanded from the first to the fifth semester. To this end, projects are worked on in close coordination with partner modules that deal with digitization topics and gradually increase in complexity over the course of the degree program.

2 Graduate profile

The Bachelor's degree program in Vehicle Development trains technically competent and creative engineers who, with their holistic approach to design in the automotive industry and related fields, understand and thus improve or create vehicles and vehicle systems.

A *Understanding Engineering Fundamentals*
Students understand general engineering fundamentals by first solving general problems independent of automotive engineering at the undergraduate level to later classify problems through abstraction.

B *Analyzing and Synthesizing in Engineering*
Students analyze and synthesize engineering problems by solving various projected tasks in a team during the course of their studies in order to later be able to solve engineering problems with an open mind and by choosing the right tools.

C *Understanding and Specifying Digital Vehicle Systems*
Students understand digital vehicle systems and are able to specify them by being repeatedly confronted with tasks from the field of digitization throughout the entire course of their studies in order to be able to specify software-driven vehicle developments later on.

D *Applying CAE Tools*
Students will be able to apply various CAE tools at different points in the development process, for example by using CAD systems, FEM systems and systems for Augmented Reality in their studies in order to find the best possible solutions later in vehicle development.

E *Planning, performing and soundly evaluating experiments and simulations*
Students will be able to use real and simulated experimental setups by having independently defined experiments based on the problem in various practical courses in order to later independently perform specific tests to validate the development results.

F *Selecting Manufacturing Processes from a Technical, Economic and Ecological Point of View*
Students will be able to evaluate different manufacturing processes by knowing the technological, economic and ecological value of common manufacturing processes in the automotive industry in order to define the manufacturing requirements for the vehicle part later in the development process.

G *Planning and Managing Projects*
The students know the common methods for project management and can use them independently by working on various projects during the course of their studies and have to finish them as a group in order to be able to cope with complex challenges later on in vehicle development and to manage projects in a well-arranged manner in a leading function.

3 Fields of activity

The automotive industry places high demands on future graduates in order to be able to solve the upcoming challenges together with them. This industry in particular is massively driven by societal and political needs in this regard, which essentially concern compliance with climate protection targets and increasing digitization.

Against this background, three future core topics in the field of automotive engineering have been identified for the Vehicle Development degree program:

- Entire vehicle
- Electromobility
- Digitization

The aim of the program is therefore to prepare students in these core areas for their future tasks in the companies concerned. The overarching professional activity areas are:

- *Designing Vehicles and Vehicle Systems*
  Future engineers will design vehicles and vehicle subsystems in their professional environment. This means that they will analyze problems and develop solution concepts. With the specifications from the specification sheet, various concepts are analyzed and finally selected.
- *Testing Vehicles and Vehicle Systems*
  Graduates will test engineering designs through numerical simulations and real-world testing, demonstrating that all legal and normative requirements are met.
- *Manufacturing Vehicles and Vehicle Systems*
  As vehicle developers, graduates accompany the highly complex manufacturing process and use their findings to optimize the components used for large-scale production.

4 Study plan

The first two semesters in the program provide the engineering fundamentals for all students. From the third semester onwards, differentiation takes place depending on the chosen field of focus:

Automotive Engineering
The classical mechanical engineering direction leads through typical assemblies and components of a vehicle and deals with their calculation and dimensioning. Here - with a few exceptions - reference is also made to future vehicle developments. For example, a profound understanding of vehicle dynamics is essential for both a traditional combustion engine vehicle and an electrically powered automobile.

Digital Vehicle
The second field of study addresses interested students who would like to deal with topics that have become increasingly important in recent years. The focus here will then be less on questions from the field of design and more on tasks from the field of digitization.

Independent of both specializations, the curriculum provides for so-called BITs. These are small units attached to various partner modules in the curriculum and are offered continuously over the first five semesters. The projects will then build digital competences for *all* students.

Vehicle Development (Study field: Automotive Engineering)

Fundamentals of engineering		Specialization phase			Practical and final phase	
1st semester	**2nd semester**	**3rd semester**	**4th semester**	**5th semester**	**6th semester**	**7th semester**
Engineering Mathematics 1 5 CP	Engineering Mathematics 2 5 CP	Engineering Mathematics 3 5 CP	Vibration Theory 5 CP	Automotive Production 5 CP		Interdisciplinary Qualification 5 CP
Technical Mechanics 1 5 CP	Technical Mechanics 2 5 CP	Technical Mechanics 3 5 CP	Thermodynamics and Fluid Dynamics 5 CP	Mechatronic Vehicle Systems 5 CP		Scientific Work 2 3 CP
Materials Science 1 5 CP	Materials Science 2 5 CP	Machine Elements 1 5 CP	Machine Elements 2 5 CP	Vehicle Body 5 CP	Internship semester 28 CP	Student Research Project 5 CP
Manufacturing Processes 5 CP	Electrotechnical Fundamentals 5 CP	Vehicle Electrics and Electronics 5 CP	Vehicle Sensors 5 CP	Automotive Chassis 5 CP		
Computer Science 5 CP	Technical Drawing 4 CP	CAD 3 CP	Driving Mechanics 5 CP	Vehicle Drivetrain 5 CP		Bachelor Thesis & Final oral examination 15 CP
Physics 5 CP	Business Administration 5 CP	Control Engineering 5 CP	elective 5 CP	elective 5 CP		
Scientific Work 1						
1 CP	1CP					
Digitization (BITs)						
1 CP	1 CP	1 CP	1 CP	1 CP		
32 CP	**31 CP**	**29 CP**	**31 CP**	**31 CP**	**28 CP**	**28 CP**
SF1 & SF2 & F09	SF1 & SF2	SF1				

Vehicle Development (Study field: Digital Vehicle)

Fundamentals of engineering		Specialization phase			Practical and final phase	
1st semester	**2nd semester**	**3rd semester**	**4th semester**	**5th semester**	**6th semester**	**7th semester**
Engineering Mathematics 1 5 CP	Engineering Mathematics 2 5 CP	Engineering Mathematics 3 5 CP	Artificial Intelligence 5 CP	Automotive Production 5 CP		Interdisciplinary Qualification 5 CP
Technical Mechanics 1 5 CP	Technical Mechanics 2 5 CP	Computer Science 2 5 CP	Thermodynamics and Fluid Dynamics 5 CP	Hygrogen Technology 5 CP		Scientific Work 2 3 CP
Materials Science 1 5 CP	Materials Science 2 5 CP	Automated Driving 5 CP	Autonomous Driving 5 CP	Electromobility 5 CP	Internship semester 28 CP	Student Research Project 5 CP
Manufacturing Processes 5 CP	Electrotechnical Fundamentals 5 CP	Vehicle Electrics and Electronics 5 CP	Vehicle Sensors 5 CP	Energy Storage 5 CP		
Computer Science 5 CP	Technical Drawing 4 CP	CAD 3 CP	Driving Mechanics 5 CP	Connected Driving 5 CP		Bachelor Thesis & Final oral examination 15 CP
Physics 5 CP	Business Administration 5 CP	Control Engineering 5 CP	elective 5 CP	elective 5 CP		
Scientific Work 1						
1 CP	1CP					
Digitization (BITs)						
1 CP	1 CP	1 CP	1 CP	1 CP		
32 CP	**31 CP**	**29 CP**	**31 CP**	**31 CP**	**28 CP**	**28 CP**
SF1 & SF2 & F09	SF1 & SF2	SF2				

Electives in both fields

Automotive Engineering	**Digital Vehicle**
Commercial Vehicle Technology	Advanced CAD
Fundamentals of Structural Durability	Calculation of Fiber Composite Components
Fuel Injection Technology	Modern Battery Management
Surface and Coating Technology	Virtual Product Development
Car Hydraulics	Composite Design
Tribology and Automotive Operating Fluids	Introduction to Matlab
Combustion Engines	Chassis Simulation Technology
Expert Services 1	Vehicle Safety
Expert Services 2	Lightweight Construction
Materials Testing	eDrive
Vehicle Restoration	eMotorsports

5 Modules

5.1 Advanced CAD

Module number:	5230
Module title in German:	Advanced CAD (CAD 2)
Module type:	elective
ECTS Credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year
Module responsible:	Prof. Dr.-Ing. Ch. Ruschitzka
Lecturer:	Prof. Dr.-Ing. Ch. Ruschitzka
Learning outcome:	Students will understand the differences between the types of curves and surfaces found in vehicle construction. They will be able to design complex curves and surfaces in a space using a 3D CAD system to create Class A and Class B freeform surfaces, which are important for vehicle manufacturing. They can analyze the surfaces with appropriate tools and evaluate the quality of the surfaces. In addition, the participants will be able to apply CAD-specific parametrics, knowledge-based rules, design tables, and macro programming to automate and accelerate the design and development process using the CAD system.
Module content:	Fundamentals • Terminology of CAD technologies • Automation of the design process with CAD • Conceptual structure of CAD systems • DMS, PDM, PLM systems • Data and model structures in CAx systems • Virtual development processes in automotive engineering Volume modeling • Design methodology / structured modeling • Parametric modeling • Rule based design

	• Feature technologies • Macro programming Surface modeling • Construction of Class A and Class B freeform surfaces • Analysis of freeform surfaces • Method for reverse engineering • Vehicle sheet metal construction
Teaching and learning methods:	lecture, practical training, project-based teaching
Assessment method:	term paper, practical exam, oral exam
Workload: (25 - 30 h ≙ 1 ECTS credit) :	150h
Contact hours:	120h
Self-study:	30h
Recommended prerequisites:	
Mandatory requirements:	PC or laptop with current Windows operating system (64bit) CAD, as the CAD modeling skills developed there are deepened with respect to knowledge-based automation as well as surface modeling.
Recommended reading:	• CATIA V5 Flächenmodellierung, Patrick Kornprobst, Hanser Verlag • CATIA V5-6 Flächenmodellierung – Parametrik – Knowledgeware, Patrik Kornprobst & Sven Ausmeier, Hanser Verlag • Konstruieren mit CATIA V5: Methodik der parametrisch-assoziativen Flächenmodellierung, Egbert Braß, Hanser Verlag • Kochbuch CATIA V5 automatisieren – Vom PowerCopy bis zur C#-Programmierung, Jens Hansen, Hanser Verlag
Use of the module in other degree programs:	none
Special features:	digital synchronous lectures and practical training, asynchronous additional exercises
Last update:	May 10, 2022

5.2 Aerodynamics

Module number:	5122
Module title in German:	Aerodynamik
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. K.-U. Münch
Lecturer:	Prof. Dr.-Ing. K.-U. Münch
Learning outcome:	The students • can describe the basic relationships of the flow around blunt bodies of a vehicle, • can explain the relationship between vehicle resistance, downforce, and mechanisms of air conditioning and pollution, • are able to transfer the above-mentioned relationships to different vehicle types.
Module content:	• Introduction/overview/motivation • Fundamentals of fluid mechanics (repetitorium), key figures of automotive aerodynamics, wind tunnel technology, wind tunnel measurement techniques, phenomena of flow separation • Partial drag and detail optimization, lift on vehicles, pollution, aeroacoustics, aerodynamics, aerodynamics of commercial vehicles, aerodynamics of racing vehicles • Vehicle design
Teaching and learning methods:	• On-site teaching (lecture) • Practical exercises in the wind tunnel
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	basic knowledge of thermodynamics and fluid mechanics
Mandatory requirements:	none
Recommended reading:	*Hucho, W.H.:* Aerodynamik des Automobils, Vieweg, 2013
Use of the module in other degree programs:	none
Special features:	practical exercises in the wind tunnel
Last update:	October 25, 2021

5.3 Automated Driving

Module number:	
Module title in German:	Automatisiertes Fahren
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. rer. nat. Edwin Kamau
Lecturer:	Prof. Dr. rer. nat. Edwin Kamau
Learning outcome:	Students will be able to make basic statements about the technical challenges involved in the automated operation of vehicles by • learning about the requirements for automated motor vehicles and • analyzing various technical solutions for this, in order to be able to later participate in the development of automated automotive systems.
Module content:	• Classification of automated systems • Requirements for automated motor vehicles • Actuators and sensors • Image processing methods • Signal processing • Simulation of automated driving functions
Teaching and learning methods:	• on-site lecture • exercises in small groups • practical training
Assessment method:	written exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module in Electrotechnical Fundamentals
Mandatory requirements:	none
Recommended reading:	Botsch, Utschick: Fahrzeugsicherheit und automatisiertes Fahren, Carl Hanser Verlag Bertram: Automatisiertes Fahren 2020, Springer Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	June 8, 2022

5.4 Automotive Production

Module number:	
Module title in German:	Automobilproduktion
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	once a year in the winter semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students will be able to name all the steps in an automotive production process by • mapping the entire value chain, • understanding the relationship between suppliers and OEMs and • discussing the methods for quality assurance, in order to be able to make informed decisions later on in the event of problems in the planning or operation of an automotive production facility.
Module content:	• Segments of a modern automobile production • Manufacturing, joining and assembly processes • Painting processes • Subcontracting strategies • Certification procedures • Clocking in final vehicle assembly
Teaching and learning methods:	• on-site lecture • project-oriented work in small groups
Assessment method:	written examination (50%), term paper (50%)
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module Production Engineering
Mandatory requirements:	none
Recommended reading:	Aurich: Automobilproduktion, Springer Verlag Wallentowitz, Freialdenhoven, Olschewski: Strategien in der Automobilproduktion - Technologietrends und Marktentwicklungen, Vieweg Teubner Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 19, 2021

5.5 Autonomous Driving

Module number:	
Module title in German:	Autonomes Fahren
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr. Ing. Edwin Kamau
Lecturer:	Prof. Dr. Ing. Edwin Kamau
Learning outcome:	Students will be able to use basic and advanced techniques for autonomous driving by • designing and implementing hardware and software components for autonomous vehicles and • discussing the advantages and disadvantages of such systems in special driving situations to be able to later make informed decisions in the development of systems for autonomous control.
Module content:	• Properties of different sensor systems • System architecture • Environment detection • Data processing • Security • Tests and residual risk • Ethical issues
Teaching and learning methods:	• on-site lecture • exercises in small groups • practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	the modules Control Engineering and Automated Driving
Mandatory requirements:	none
Recommended reading:	Maurer, Gerdes, Lenz, Winner: Autonomes Fahren, Springer-Verlag Lalli: Autonomes Fahren und die Zukunft der Mobilität, Springer-Verlag Riesner, et al.: Autonome Shuttlebusse im ÖPNV, Springer-Verlag Islakar: Autonomes Fahren. Ethische, rechtliche und gesellschaftliche Herausforderungen, Science Factory
Use of the module in other degree programs:	none
Special features:	none

Last update: June 8, 2022

5.6 Bachelor Thesis and Colloquium

Module number:	
Module title in German:	Bachelorarbeit und Kolloquium
Module type:	mandatory
ECTS credits:	15
Language:	German
Module duration:	13 weeks
Recommended semester:	7th
Frequency:	winter and summer semester
Module responsible:	all lecturers of the Institute of Automotive Engineering
Lecturer:	all lecturers of the Institute of Automotive Engineering
Learning outcome:	The students • can work independently, • can apply the specialist knowledge acquired in the course of study in a problem-oriented manner, • can apply the scientific methods taught in the course of study, • are able to think in interdisciplinary contexts, • are able to independently organize project planning and time management, • are able to work on time, • can document their results appropriately, • are able to present and defend the results of their work in a colloquium .
Module content:	The bachelor thesis is usually an independent investigation with a constructive, experimental design or other engineering task from automotive engineering and a sufficient description and explanation of its solution. In professionally appropriate cases, it may also be a written term paper with specialized literary content.
Teaching and learning methods:	Independent work on the assignment with minimal guidance from the instructor.
Assessment method:	Bachelor thesis (written paper) Colloquium (oral exam, presentation)
Workload: (25 - 30h ≙ 1 ECTS credit) :	450h
Contact hours:	20h
Self-study:	430h
Recommended prerequisites:	none
Mandatory requirements:	according to the examination regulations
Recommended reading:	depending on project topic
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 24, 2021

5.7 Calculation of Fiber Composite Components in Automotive Engineering

Module number:	…
Module title in German:	Berechnung von Faserverbundbauteilen in der Fahrzeugtechnik
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	Dr. M. Möller
Lecturer:	Dr. M. Möller
Learning outcome:	The students • know the basic properties of polymer fiber composites and are able to describe the advantages and disadvantages of different material combinations, • know the fundamentals of strength theory and material modeling, • can calculate the mechanical properties of the material combination based on micromechanical models, • are able to describe the material behavior of multilayer composites on the basis of continuum mechanics approaches and to name the advantages of certain composite architectures, • know various theories of strength verification for fiber-plastic composites and guidelines for the material-specific design of fiber-reinforced components in automotive engineering.
Module content:	• Fundamentals of polymer fiber composites • Calculation fundamentals of strength of materials theory • Spatial and plane stress state, basics of disk and plate theory • Fundamentals of material modeling and material laws of anisotropic materials • Mesh theory and classical laminate theory • Fracture criteria and strength evaluation of fiber-reinforced plastic composites (FRP) • Guidelines for the dimensioning and design of FRP in automotive engineering • Fundamentals of the experimental determination of mechanical parameters for fiber composites
Teaching and learning methods:	• on-site teaching (lecture) • on-site exercises and practical trainings in small groups • classroom discussion • if applicable, independent work on a small application-related project in small groups, followed by a presentation
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Technical Mechanics 1 & 2, Engineering Mathematics 1, Materials Science 1
Mandatory requirements:	
Recommended reading:	H. Schürmann: Konstruieren mit Faser-Kunststoff-Verbunden, VDI-Buch Series, Springer-Verlag Berlin Heidelberg 2005, ISBN: 978-3-540-26485-9.

	W. Becker und C. Mittelstedt: Strukturmechanik ebener Laminate, Technische Universität Darmstadt FB Mechanik - Bibliothek, 2019, ISBN: 3935868995.
Use of the module in other degree programs:	none
Special features:	none
Last update:	October 20, 2021

5.8 Fundamentals of Structural Durability

Module number:	5250
Module title in German:	Betriebsfestigkeit - Grundlagen
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. P. Krug
Lecturer:	Prof. Dr.-Ing. P. Krug
Learning outcome:	The students • know the material science processes under different component loads and the relevant test methods for characterizing the relevant material behavior in order to determine suitable test procedures. • can describe and apply the experimental methods for determining fatigue properties and compare different damage accumulation models in order to calculate the service life of cyclically loaded, simple components. • know adequate methods for service life extension in order to be able to specifically identify the appropriate process, taking into account the material and the load collective.
Module content:	• Deformation behavior of different material groups under static, cyclic and dynamic load, fatigue behavior of metallic materials, experimental fundamentals of fatigue strength operational strength verification, fundamentals of wear, fundamentals of corrosion, fundamentals of creep loading, fundamentals of special loads.
Teaching and learning methods:	• on-site teaching • practical training project • guest speakers • technical discussion (individual) • exercises in English • presentations in English
Assessment method:	oral exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	50h
Self-study:	100h
Recommended prerequisites:	All mandatory modules from the mathematical-scientific as well as the engineering-scientific fundamentals.
Mandatory requirements:	none
Recommended reading:	E. Haibach, „Betriebsfestigkeit“, Springer Verlag D. Radaj; M. Vormwald, „Ermüdungsfestigkeit“ Springer Verlag H. Gudehus, H. Zenner, „Leitfaden für eine Betriebsfestigkeitsrechnung“ Stahleisen Verlag in English: J. A. Bannantine, J.L. Handrock, J. J. Comer; „Fundamentals of Metal Fatigue Analysis D. Radaj, C. M. Sonsino, W. Fricke, “Fatigue Assessment of Welded Joints by Local Approaches”, Woodhead Publishing (sophisticated+demanding)

Use of the module in other degree programs:	The module is also offered in the study program B. Eng. Production and Logistics.
Special features:	none
Last update:	November 22, 2021

5.9 Business Administration

Module number:	4020
Module title in German:	Betriebswirtschaftslehre
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Dr. pol. Kim
Lecturer:	Dr. pol. Kim
Learning outcome:	The students classify business management fundamentals in the company process and assess economic interrelationships; they plan commercial production processes, recognize decision-relevant interrelationships in the financing area and learn to create a business plan, by assigning accounting procedures, recognizing payment flows and the associated flow of goods, and planning and analyzing the strategic orientation of companies, so that they apply economic interrelationships in a problem-oriented manner within the scope of their industrial activities and successfully resolve conflicting goals in the company procedures. Students formulate successful marketing strategies in the capital goods sector. They design sales structures and activities; they identify influencing factors in the sales of highly competitive product groups, by transferring the four key influencing variables in product marketing (4Ps) and deriving strategies from them, so that they can successfully introduce new products to the market and consolidate existing products within the scope of their professional activities.
Module content:	Marketing/Fundamentals • Buyer behavior • The marketing plan as the basis for the marketing strategy • Fundamentals in sale • Influence of operational marketing on sales Financing and investment • Fundamentals • Investment decisions • Financing decisions • Risk Management Fundamentals of business administration • Why are there companies? • Needs and goods • The carriers of the economy • The principles of business thinking and acting • Challenges and goals of organizations Accounting • Fundamentals of accounting • Origins and understanding of roles • Internal accounting • External accounting Business plan • Business plan fundamentals • Market analysis • Cost and price strategy • Process and logistics

Teaching and learning methods:	The lecture provides theoretical knowledge and activates students through classroom assessment techniques. Students are encouraged to interact through peer instruction. The exercise is closely linked to the lecture and deepens the knowledge by means of case studies; group work promotes the participants' ability to work in a team.
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	• Wöhe, Günter et al. (2016); Einführung in die Allgemeine Betriebswirtschaftslehre; 26. ed.; München: Vahlen • Straub, Thomas (2015); Einführung in die Allgemeine Betriebswirtschaftslehre; 2. ed.; Hallbergmoos: Pearson • Eisenführ, Franz (2004); Einführung in die Allgemeine Betriebswirtschaftslehre; 4. ed.; Stuttgart: Schäffer-Poeschel • Kotler, Philip (2016); Grundlagen des Marketing; 6. ed.; Hallbergmoos: Pearson Deutschland GmbH • Bitz, Michael (Hrsg.) (2005): Vahlens Kompendium der Betriebswirtschaftslehre; 5. ed.; München: Vahlen • Schultz, Volker (2003): Basiswissen Rechnungswesen: Buchführung, Bilanzierung, Kostenrechnung, Controlling; 3. ed.; München: dtv • Klunzinger, Eugen (2009); Grundzüge des Gesellschaftsrechts; 15. ed.; München: Vahlen
Use of the module in other degree programs:	Bachelor Mobile Machinery, Bachelor Energy and Building Services Engineering, Bachelor Rescue Engineering, Bachelor Mechanical Engineering
Special features:	none
Last update:	October 20, 2021

5.10 CAD

Module number:	2070 2080
Module title in German:	**CAD (CAD/TZ)**
Module type:	mandatory
ECTS credits:	7
Language:	German
Module duration:	two semesters
Recommended semester:	2nd and 3rd
Frequency:	once a year in the summer semester and in the following winter semester
Module responsible:	Prof. Dr.-Ing. Ch. Ruschitzka
Lecturer:	**CAD:** Prof. Dr.-Ing. Ch. Ruschitzka, **TZ**: adjunct lecturers (Lehrbeauftragte)
Learning outcome:	Students will be able to create technical drawings by understanding the representation standards of technical drawing and applying them to any machine elements and assemblies. They know the necessity of tolerances and fits and can calculate and select them based on general tolerances or the ISO system. They will use the basic techniques of descriptive geometry to construct unwindings and projections using rulers and compasses. With this knowledge, they can design standard-compliant technical drawings of components and assemblies of low and medium complexity, taking into account specified boundary conditions. Students understand the importance of CAD technology to the design and development process. Starting from a 2D design initially presented in a technical drawing, they can mentally design various modeling methods and, taking into account criteria for functional and production-oriented design, select a suitable method and apply it in the 3D CAD system. To do this, they can also design 3D surfaces and integrate them into volumes. This allows them to create mechanical assemblies by designing parametric, feature-based 3D solids using the 3D CAD system, assembling them into assemblies, and documenting them in 2D digital drawings.
Module content:	**Technical Drawing** • Representation standards: standardized representation and dimensioning, views, sectional views, thread representations, surface specifications, drawing types, title blocks, parts lists, workpiece and model recordings. • Tolerances and fits: dimensional, form and position tolerances, fits (general tolerances, ISO system, fit selection). • Fundamentals of descriptive geometry: central and parallel projections, orthogonal two- and three-table projection, intersection of the plane with the body, penetrations and unwindings of bodies. **Fundamentals of 3D modeling and drawing creation with CAD**

	• Creation of sketch-based 3D solid models • Construction of freeform surfaces and integration into volumes • Application of different CAD modeling methods • Building 3D assemblies • 2D drawing derivation
Teaching and learning methods:	• on-site or online/remote teaching (lecture/exercise) • learning in small groups (calculation exercises for the ISO fitting system) • working independently on technical drawing and descriptive geometry tasks in small groups • online/remote exercises and practical training on the CAD system most relevant to automotive engineering • use of modular, small tasks, which enable the students to step by step apply the 3D methods in practice • individual technical discussions to teach methodology
Assessment method:	term paper and practical exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	210h
Contact hours:	160h
Self-study:	50h
Recommended prerequisites:	
Mandatory requirements:	PC or laptop with Windows operating system (64 bit) to run the 3D CAD system
Recommended reading:	*Hoischen: TECHNISCHES ZEICHNEN, Cornelsen Girardet* *Susanna Labisch, Christian Weber: TECHNISCHES ZEICHNEN, Vieweg Verlag.*
Use of the module in other degree programs:	none
Special features:	digital synchronous lectures and exercises, asynchronous supplementary exercises
Last update:	May 10, 2022

5.11 Composite Design

Module number:	5296
Module title in German:	Composite Design
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the summer semester
Module responsible:	Dipl.-Ing. J. Gehrmann
Lecturer:	Dipl.-Ing. J. Gehrmann
Learning outcome:	The students • are able to describe the advantages and disadvantages of this group of materials and use them for technical applications, • can name common FRP materials and describe their processing methods, • can implement FRP components in the design in accordance with the material, • are able to lay out a laminate with computational aids.
Module content:	• Basics of FRP materials • Overview of common processing methods • Basic rules of construction • Applied calculation of laminates • Examples from application areas
Teaching and learning methods:	• on-site teaching (lecture) • classroom discussion • exercises with practical examples • case studies in small groups
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Basic knowledge of the modules Materials Science, Mechanics (STK, ES, KI, SW) and Lightweight Construction / FEM
Mandatory requirements:	none
Recommended reading:	*H. Schürmann:* Konstruieren mit Faser-Kunststoff-Verbunden, VDI-Buch Series, Springer Verlag 2005, ISBN 3540402837 *AVK e.V. (Hrsg.):* Handbuch Faserverbundkunststoffe, 3rd edition, Vieweg+Teubner Wiesbaden 2010, ISBN 978-3-8348-0881-3
Use of the module in other degree programs:	none
Special features:	none
Last update:	October 10, 2021

5.12 Digitization

Module number:	
Module title in German:	Digitization
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	five semesters
Recommended semester:	Semester 1 (BIT^{S1}); Semester 2/3 (BIT^{S2}); Semester 4/5 (BIT^{S3})
Frequency:	once per academic year
Module responsible:	Prof. Dr. rer. nat. Edwin Kamau
Lecturer:	Prof. Dr. T. Viscido, Prof. Dr. E. Kamau

Learning outcome:

	What?	What with?	What for?
BIT^{S1}	Students will be able to adapt digital solutions in a static experimental setup to autonomize a vehicle using a microcontroller, sensors and actuators,	by outputting sensor data and analyzing it with regard to plausibility and accuracy, by executing required functions (e.g. line tracking, distance detection) and parameterizing them, by sifting through source code and annotating it with predetermined comments at associated locations,	to be able to actively shape the digital transformation of the automotive industry.
BIT^{S2}	Students will be able to adapt digital solutions in a simple, dynamic experimental setup to autonomize a vehicle using a microcontroller, sensors and actuators,	by executing and parameterizing required functions (e.g. course correction, distance detection), by outputting sensor data (e.g. distance sensors, camera) and analyzing them with regard to plausibility and accuracy,. by using sensor data to generate autonomous decision making, by creating, optimizing and extending source code, as well as documenting this in a comprehensible manner through comments in the appropriate place,	
BIT^{S3}	Students will be able to develop digital solutions in a networked experimental setup to autonomize a vehicle using a microcontroller, sensors, actuators and	by executing required functions and parameterizing them,. by generating autonomous decision	

	communication interfaces,	making through object recognition, by utilizing sensor data and transmitting it to a stationary, external infrastructure for further processing, by utilizing external data for the implementation of an autonomous function, which are transmitted via a communication interface, by creating and extending source code and documenting it in a comprehensible manner through comments in the appropriate place.	

Module content:	**BIT^{S1}** (1st semester) ▪ Bring small vehicle to a stop in front of an obstacle. ▪ Change the travel speed depending on the distance of the obstacle. ▪ Output and analyze sensor data of the distance measurement. ▪ Output and analyze sensor data of line detection. **BIT^{S2}** (2nd / 3rd semester) ▪ Make a micro-vehicle drive autonomously from a starting point to an ending point as fast as possible in a maze environment. ▪ Avoid collisions with obstacles. **BIT^{S3}** 4th / 5th semester ▪ Make a micro-vehicle in a parking garage autonomously approach a parking position and park based on a database. ▪ Independent detection of free parking spaces. ▪ Evaluation of the individual situation of parking spaces with regard to occupancy, category of parking space (loading parking space, disabled parking space, ...) and feedback to stationary infrastructure. ▪ Collisions with obstacles must be avoided.
Teaching and learning methods:	blended learning, collaborative work, project-based group work
Assessment method:	oral examination and another type of exam (performance examination, submission)
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	30 h
Self-study:	120h
Recommended prerequisites:	A successful participation in the module Computer Science is recommended for the participation in the BIT^{S2} project.
Mandatory requirements:	Participation in the BIT^{S2} project: successful participation in BIT^{S1} Participation in the BIT^{S3} project: successful participation in BIT^{S1} and BIT^{S2}

Recommended reading:	Provided on a task-by-task basis at the beginning of projects.
Use of the module in other degree programs:	none
Special features:	The module is taught in the first five semesters in three consecutive projects (BIT^{S1}, BIT^{S2} and BIT^{S3}) are organized.
Last update:	June 8, 2022

5.13 eDrive - Electric Drives in Vehicles

Module number:	5116
Module title in German:	eDrive – Elektrische Antriebe in Fahrzeugen
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. U.-M. Gundlach
Lecturer:	Prof. Dr.-Ing. U.-M. Gundlach
Learning outcome:	Students will know the basic structure of the electrified powertrain in hybrid and electric vehicles with its components: electrochemical storage, power electronics and electric motor. In particular, they will gain a deeper understanding of the basic modes of operation, properties and operating behavior of different electrical drives (direct current machine, asynchronous machine, synchronous machine). They are able to size drive motors in terms of their power and torque characteristics based on energy and driving power requirements, using motor-specific formulas in complex representation to define drive motor requirements in the development process. In addition, they can plan a motor control system in a well-founded manner by defining the parameters of the field-oriented drive control system, taking into account the motor parameters, in order to optimize the operating behavior of the drive motor in test setups.
Module content:	• *Perspectives of alternative mobility:* mobility and the environment, energy balances of fossil and renewable energy sources, vehicle emissions, driving cycles, evolution of electric drive technology in vehicles, design variants of the electrified powertrain. • *Drive fundamentals:* drive physics and driving power requirements, load and drive characteristics, stability of the operating point. • *Electrical machines:* electromagnetic fundamentals, winding variants and generation of magnetic fields in electrical machines, losses and thermal behavior, design, functioning and operating characteristics of direct current and three-phase machines (DC, ASM, PSM), control of the three-phase machine with the space vector theory. • *Power electronics:* semiconductors of power electronics, circuits for DC and AC converters, control methods for DC converters and inverters, pulse width modulation, charging technology for vehicles. • *Electrochemical energy storage:* storage variants, basics of electrochemical storage, charging and discharging processes, interconnection of storage cells, thermal behavior, battery management system.

Teaching and learning methods:	• media-supported on-site teaching (lecture) with a digital provision of study-related learning material via the intranet-based learning platform (ILIAS) • pre-calculus exercise and moderation in the application of solution methods to typical, practice-oriented tasks
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Physics, Engineering Mathematics, Electrical Engineering, Vehicle Electrics and Electronics
Mandatory requirements:	none
Recommended reading:	A detailed literature review will be provided during the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	May 24, 2022

5.14 Introduction to MATLAB

Module number:	5308
Module title in German:	Einführung in Matlab
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	Dr.-Ing. Emad Farshizadeh
Lecturer:	Dr.-Ing. Emad Farshizadeh
Learning outcome:	The students will • know the basics of the MATLAB development environments commonly used in the industry, • be able to create complete program codes, • gain experience in the practical use of the development environment MATLAB.
Module content:	• Data objects • Arithmetic operations • 2D and 3D graphics • Handle graphic • Programming m-files and m-functions • Logical and relation operators • Control structures • Debugging • Use of MATLAB functions (e.g., integration, interpolation, regression, initial value tasks)
Teaching and learning methods:	• seminar teaching • practical programming exercises • independent programming work
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	basic knowledge of Engineering Mathematics and Computer Science
Mandatory requirements:	none
Recommended reading:	The current literature will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	October 20, 2021

5.15 Fuel Injection Technology

Module number:	5150
Module title in German:	Einspritztechnik
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. K.-U. Münch
Lecturer:	Prof. Dr.-Ing. K.-U. Münch
Learning outcome:	The students will be able to • explain the essential terms and relationships of engine injection technology, • describe the main tasks of fluid atomization in gasoline and diesel engines, • explain the relationship to pollutant emissions and fuel consumption, • classify the necessity of developing new drive systems in relation to the state of the art.
Module content:	• Introduction, overview, motivation • System structure of cam-driven diesel injection systems, in-line injection pumps, distributor pump, PD/PLD, relief valves and high-pressure injection lines, injection nozzles, CR system, low-pressure systems for diesel engines • System structure storage injection systems • Influence of injection systems on mixture formation and emissions, measurement methods/test equipment, simulation of high-pressure systems, gasoline engine injection systems, intake manifold injection, direct-injection gasoline engine, development trends of gasoline engine injection • Future developments: new fuels, new drives
Teaching and learning methods:	• on-site teaching (lecture)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	64h
Self-study:	86h
Recommended prerequisites:	basic knowledge from the module Thermodynamics and Fluid Mechanics
Mandatory requirements:	none
Recommended reading:	*Bosch:* "Dieselmotor-Management", Vieweg, Braunschweig, 2014
Use of the module in other degree programs:	none
Special features:	none
Last update:	October 25, 2021

5.16 Electromobility

Module number:	
Module title in German:	Elektromobilität
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	once a year in the winter semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students will be able to name the opportunities and challenges in the field of electromobility by • discussing the necessary technical, social and political framework conditions and • learning about the different technical solutions in the field of electromobility in order to later design optimal electric mobility concepts.
Module content:	• The future of electromobility • Special concepts for short and long distances • Electromobility for commercial vehicles • Plug-in hybrids • Various drive concepts • Charging infrastructure • Urban electric mobility concepts
Teaching and learning methods:	• on-site lecture • exercises in small groups • practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module in Electrotechnical Fundamentals
Mandatory requirements:	none
Recommended reading:	Karle: Elektromobilität – Grundlagen und Praxis, Carl Hanser Verlag Müller, Schmidt, Steber: Elektromobilität, Vogel Communications Doppelbauer: Grundlagen der Elektromobilität, Springer-Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 19, 2021

5.17 Electrotechnical Fundamentals

Module number:	2310
Module title in German:	Elektrotechnik
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	2nd
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. Toni Viscido
Lecturer:	Prof. Dr.-Ing. Toni Viscido
Learning outcome:	The students will be able to • describe the electrical engineering principles relevant to vehicle electrics and electronics, • explain the properties of selected electrical components in the vehicle as well as electronic components, • examine and calculate electrical circuits of direct and alternating current technology as well as simpler semiconductor circuits, • design op-amp circuits and analog filters.
Module content:	Electrotechnical Fundamentals (energy, voltage, current, electric field, passive/active, linear/non-linear dipoles, conductivity, temperature effect, electrical hazards) - Energy storage and management (energy storage overview, starter battery) - Direct current circuits (DC circuits) (branched DC circuits, Kirchhoff, equivalent two-pole source, mesh current method, throttle potentiometer, Wheatstone's bridge for air mass measurement) - Alternating current circuits (AC circuits) (complex AC calculation, pointer diagram, complex power calculation) - Operational amplifier circuits - Analog filters
Teaching and learning methods:	• media-supported on-site teaching with a digital provision of course-related learning material via an intranet-based learning platform (lecture) • pre-calculus exercise as well as moderation in the application of solution methods to typical practice-oriented tasks (exercise)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Physics, Mathematics for Engineers 2
Mandatory requirements:	none
Recommended reading:	Elektrotechnik (Pearson Studium - Elektrotechnik) von Manfred Albach (Autor) An additional detailed literature review will be provided during the lecture.
Use of the module in other degree programs:	none

Special features:	none
Last update:	October 20, 2021

5.18 eMotorsports

Module number:	
Module title in German:	eMotorsports
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	The students are able to organize and work on extensive projects based on a division of labor by • designing a battery electric powered race car • financed through sponsors and • participating in international racing competitions with that car to be able to use their knowledge from electromobility and their project management skills later in their professional environment.
Module content:	• Construction of a carbon monocoque • Acquisition of sponsors • Financial and schedule controlling in complex projects • Human resources management • Betriebswirtschaftslehre • Critical path in project management
Teaching and learning methods:	group work project work
Assessment method:	term paper
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module in Computer Science
Mandatory requirements:	none
Recommended reading:	none
Use of the module in other degree programs:	none
Special features:	none
Last update:	December 2, 2021

5.19 Energy Storage

Module number:	
Module title in German:	Energiespeicher
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	once a year in the winter semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students will be able to calculate and evaluate different electrical storage technologies by • analyzing different storage systems, including possible converter systems, independent of technology and • describing them using a universal memory model, to later select and dimension suitable electrical energy storage systems.
Module content:	• Fundamentals of electrical storage systems • Universal storage models • Fundamentals for the calculation of memories • Direct electrical storage • Battery storage • Gas storage systems • Storage management systems
Teaching and learning methods:	• on-site lecture • exercises in small groups • practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module in Electrotechnical Fundamentals
Mandatory requirements:	none
Recommended reading:	Sterner, Stadler: Energiespeicher – Bedarf, Technologien, Integration, Springer-Verlag Schmiegel: Energiespeicher für die Energiewende, VDE-Verlag Kormanicki, Styczynski, Lombardi: Elektrische Energiespeichersysteme, Springer-Verlag
Use of the module in other degree programs:	none
Special features:	none

Last update: November 19, 2021

5.20 Driving Mechanics

Module number:	3010
Module title in German:	Driving Mechanics
Module type:	mandatory
ECTS credits:	5
Language:	German (if necessary English contents / literature)
Module duration:	one semester
Recommended semester:	4th
Frequency:	twice a year in summer and winter semester
Module responsible:	Prof. Dr.-Ing. M. Frantzen
Lecturer:	Prof. Dr.-Ing. M. Frantzen
Learning outcome:	The students will be able to • understand the power generation on the wheel, • distinguish dynamic and static wheel radius, • know and analyze driving mechanics basics and facts, • calculate axle and wheel loads, force and power requirements, • develop typical vehicle mechanical characteristic diagrams, • analyze the fuel consumption of vehicles, • develop brake force distribution diagrams, • compare geometric and physical effects during cornering, • investigate and calculate transverse dynamic relationships.
Module content:	• Fundamentals, center of gravity, mass moments of vehicles • Wheel and tire, forces, adhesion, slip, different wheel radii • Static and dynamic axle load, driving resistances, power requirements • Vehicle identification, characteristic diagrams of drives and identification converters • Driving performance, driving condition and fuel consumption diagram • Driving limits, front, rear and all-wheel drive, brakes, brake force distribution • Cornering (steady-state cornering behavior), lateral dynamics (single-track model)
Teaching and learning methods:	lecture, exercise, computer-based practical training with Excel and IPG CarMaker
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	70h
Self-study:	80h
Recommended prerequisites:	Engineering Mathematics, Physics (Mechanics, Kinetics, Kinematics).
Mandatory requirements:	none
Recommended reading:	Breuer, S.; Rohrbach-Kerl, A.: Fahrzeugdynamik, Vieweg, 2015.
Use of the module in other degree programs:	none
Special features:	practical training in CAx lab (lab approval and instruction required) or online
Last update:	November 27, 2021

5.21 Automotive Chassis

Module number:	3020
Module title in German:	Fahrwerke
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Prof. Dr.-Ing. J. W. Betzler
Lecturer:	Prof. Dr.-Ing. J. W. Betzler
Learning outcome:	The students will be able to • describe the basic driver-oriented requirements for chassis, methods for describing vehicle behavior including the relevant chassis systems and components and their functions, • apply the fundamentals learned to practical problems, • derive solutions from the analyzed problems, • evaluate the solution variants achieved, paying particular attention to driver requirements.
Module content:	Chassis requirements, methods for describing vehicle behavior, force transmission characteristics of tires, vehicle braking behavior, structure and characteristics of wheel suspensions.
Teaching and learning methods:	• on-site teaching (lecture) • seminar-based teaching and learning in small groups (from application and case studies to the development and assessment of solutions) • independent practical training in small groups (6 students) • summary of the lectures in English script in German and English
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	according to the study plan: Mechanics, Driving Mechanics
Mandatory requirements:	none
Recommended reading:	Breuer, B.; Bill, K.-H.: Bremsenhandbuch, Wiesbaden, Vieweg-Verlag, 4. ed. 2012 Robert Bosch GmbH: Kraftfahrzeugtechnisches Taschenbuch, Wiesbaden, Vieweg-Verlag, 26. ed. 2007 Hacken, Karl-Ludwig: Grundlagen der Kraftfahrzeugtechnik. 5. ed. München, Carl Hanser Verlag, 2018 Heißing, Bernd, Ersoy, Metin, Gies, Stefan (eds.): Fahrwerkhandbuch, Heidelberg, Springer-Verlag, 4. ed., 2013 Reimpell, J.; Betzler, J.W.: Fahrwerktechnik: Grundl. 5. ed. Würzburg, Vogel Buchverlag, 2005 Reimpell, J.; Stoll, H.; Betzler, J. W.: The Automotive Chassis, Oxford, Verlag Butterworth Heinemann, 2001 Reimpell, J.: Radaufhängungen, Würzburg, Vogel Buchverlag, 2. ed. 1988 Stoll, H.: Lenkanlagen und Hilfslenkungen, Würzburg, Vogel Buchverlag, 1992

Use of the module in other degree programs:	none
Special features:	none
Last update:	November 19, 2021

5.22 Chassis Simulation Technology

Module number:	5270
Module title in German:	Fahrwerk-Simulationstechnik
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Prof. Dr.-Ing. J. W. Betzler
Lecturer:	Prof. Dr.-Ing. J. W. Betzler
Learning outcome:	The students will be able to • describe basic possibilities of simulation, axle kinematics and vehicle movement, • perform basic simulations with the Adams/Car software, • analyze simulated results with regard to their relevance to vehicle dynamics, • derive possibilities for improvement of the solutions developed.
Module content:	method for simulating vehicle motion behavior, vehicle dynamics effects of parameter variations of the chassis geometry.
Teaching and learning methods:	seminar-based teaching carrying out case studies independent practical training
Assessment method:	project work and presentation
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	64h
Self-study:	86h
Recommended prerequisites:	basic knowledge especially of chassis technology, according to the study plan: Mechanics, Driving Mechanics
Mandatory requirements:	none
Recommended reading:	Heißing, Bernd, Ersoy, Metin, Gies, Stefan (eds.): Fahrwerkhandbuch, Heidelberg, Springer-Verlag, 4. ed., 2013 Reimpell, J.; Betzler, J.: Fahrwerktechnik: Grundlagen, Vogel Buchverlag, Würzburg, 2005, 5th edition, Reimpell, J.; Stoll, H.; Betzler, J. W.: The Automotive Chassis, Oxford, published by Butterworth Heinemann, 2001 Reimpell, J.: Radaufhängungen, Vogel Buchverlag, Würzburg, 1992 Further reading will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 19, 2021

5.23 Vehicle Drivetrain

Module number:	3052

Module title in German:	Fahrzeugantriebe
Module type:	mandatory
ECTS credits:	5
Language:	German / English friendly
Module duration:	one semester
Recommended semester:	5th
Frequency:	twice a year in winter and summer semester
Module responsible:	Prof. Dr.-Ing. Rainer Haas
Lecturer:	Prof. Dr.-Ing. Rainer Haas
Learning outcome:	After the successful completion of the module, students will be able to distinguish and classify different powertrain designs by learning about the structure and function of the associated components and how they interact, so that they have a sound knowledge of the overall powertrain system in professional applications. Students have learned to apply the basics of kinematics, kinetics and thermodynamics in the area of the drivetrain so that they can calculate and design components themselves as well as their operating process. Furthermore, students will be able to appropriately estimate, evaluate and compare the consumption of different drive configurations based on component efficiency. To this end, they will learn about the necessary calculation processes and analyze exemplary results in order to later be able to assess design changes or new designs with a view to consumption. They also know necessary test scopes and associated procedures. Students learn about detailed trials using a component as an example, so that they are able to develop component trials in a professional context under the supervision of experienced staff.
Module content:	• structure and function of various powertrain concepts, as well as the associated component arrangement • analysis of the drivetrain to derive development specifications • framework conditions of the vehicle industry and related strategies for the development and production • function and properties of the different power transmission paths from the primary drive to the wheel • design and comparison of different combustion engine and electric primary drives • measurement of engine power, internal work and heat flows on an internal combustion engine for the calculation of general parameters and efficiency using the example of • dynamic forms of excitation on the combustion engine and associated countermeasures • structure and operation process of couplings and hydraulic converters • structure and function of identification transformers and their machine elements in different designs • traceability of gearboxes to simple mechanical models as a tool in design and development • calculation principles of longitudinal and lateral shafts, as well as design forms and their dynamic transmission behavior • overall energy evaluation of different types of primary drives in comparison • determination of consumption and procedure for its simulation. • Metrological recording of component efficiency using the example of • fundamentals of testing based on risk assessment and FMEA in development • Test scopes derived from the requirements for durability, function and reliability using the example of • structure, components and operating procedures of all-wheel-drive vehicles in mechanical and hybrid-electric design
Teaching and learning methods:	on-site teaching applied arithmetic exercises

	group internships
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	50h
Self-study:	100h
Recommended prerequisites:	basic knowledge of physics, electrical engineering, machine elements and materials science sound knowledge of kinematics and kinetics and thermodynamics
Mandatory requirements:	none
Recommended reading:	Cornel Stan: Alternative Antriebe für Automobile / Alternative Propulsion for Automobiles Lechner, Naunheimer: Vehicle Transmissions / Automotive Transmissions Seherr-Thoss, Schmelz, Aucktor: Gelenkeund Gelenkwellen / Universal Joints and Driveshafts van Basshuysen, Schäfer: Handbuch Verbrennungsmotoren / Internal Combustion Engine Handbook Hofmann: Hybrid Vehicles / Denton: Electric and Hybrid Vehicles
Use of the module in other degree programs:	none
Special features:	material in English
Last update:	June 8, 2022

5.24 Vehicle Diagnostics

Module number:	5309
Module title in German:	Fahrzeugdiagnose
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Dr.-Ing. Oliver Brockmann
Lecturer:	Dr.-Ing. Oliver Brockmann
Learning outcome:	The students are supposed to • learn and understand the aspects and methods of current vehicle diagnostic systems in order to be able to independently read and critically interpret diagnostic data from a vehicle after completion of the module. In a holistic approach, this includes not only knowledge of and handling of on-board and off-board diagnostic systems, but also basic knowledge of how data networks and sensors work in motor vehicles.
Module content:	• state of the art vehicle diagnostics • different systems for on-board and off-board diagnostics • differentiation between OEM and multi-brand diagnostic systems • pass-Thru systems according to SAE J2534-x or ISO 22900-2 • basic operation of data networks in motor vehicles • design and function of sensors in motor vehicles • practical application of vehicle diagnostics
Teaching and learning methods:	• on-site teaching • practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	fundamentals of electrical engineering, vehicle electrics and electronics
Mandatory requirements:	none
Recommended reading:	*Zimmermann / Schmidgall:* Bussysteme in der Fahrzeugtechnik, Springer Verlag *Reif:* Automobilelektronik, Springer Verlag *Schäffer:* OBD Fahrzeugdiagnose in der Praxis, Franzis Verlag *Reif (Hrsg.):* Sensoren im Kraftfahrzeug, 2nd edition, Springer Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 4, 2021

5.25 Vehicle Electrics and Electronics

Module number:	3070
Module title in German:	Fahrzeugelektrik und Elektronik
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. Toni Viscido
Lecturer:	Prof. Dr.-Ing. Toni Viscido
Learning outcome:	The students will be able to • apply Maxwell's equations (flow, induction, source freedom) • describe in detail the mode of operation of all DC machines and assign them according to requirements • describe in detail the mode of operation of AC machines and assign them according to requirements (PMSM, asynchronous machine) • describe in detail the mode of operation of the three-phase generator in the vehicle electrical system and assign it as required • describe and calculate in detail power electronics for the control of AC machines for use in electrically driven vehicles • apply decimal, hexadecimal and binary number systems in detail • convert continuous-time and continuous-value signals into discrete-time and discrete-value signals • describe and design digital circuits for signal processing • calculate digital filters • describe digital bus systems in the automobile and calculate signals.
Module content:	• Magnetic field: • properties and characteristics, forces, electromagnetic induction • Electrical machines: • direct current machines, alternating current machines • Power electronics: • function, structure, control, design of power electronic circuits for the control of machines • Digital technology: • number systems, digital circuits, quantization, digital signal processing, digital filters, digital bus systems
Teaching and learning methods:	• media-supported on-site teaching with digital provision of study-related learning material via intranet-based learning platform (lecture) • pre-calculus exercise as well as moderation in the application of solution methods • on typical practice-oriented tasks (exercise) • • independent processing of tasks and execution of experiments in a team with other students (practical training)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	56h
Self-study:	94h

Recommended prerequisites:	Electrical Engineering, Engineering Mathematics 1-2 (complex calculus), Computer Science
Mandatory requirements:	none
Recommended reading:	Elektrotechnik (Pearson Studium - Elektrotechnik) von Manfred Albach (Autor) An additional detailed literature review will be provided during the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	October 20, 2021

5.26 Vehicle Body

Module number:	3030
Module title in German:	Fahrzeugkarosserie
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Prof. Dr.-Ing. F. Herrmann
Lecturer:	Prof. Dr.-Ing. F. Herrmann
Learning outcome:	The students will be able to • explain the basic knowledge of how body development fits into the overall development process, • describe in detail all common body construction methods and create their own body concepts, • explain the structure and function of the most important body assemblies, • create their own detailed designs of assemblies of a car body, • apply body-specific material knowledge, • describe forming and joining processes relevant to bodywork, • evaluate the feasibility of their own body designs from both a technical and a business perspective.
Module content:	• introduction (concept vehicles, marketing and vehicle definition) • construction and design of current body concepts (conventional large-series body, large-series body with alternative package concept, luxury-class sedan in aluminum, small car in aluminum, sports car in aluminum) • representation of construction • material selection • mechanical properties • assembly concepts (bumper system, doors and flaps, instrument panel cross-member) • structural concept "passive safety" / occupant restraint system • body materials (steels, semi-finished aluminum products, plastics) • body-specific forming and joining processes
Teaching and learning methods:	• lecture • repetitorium in exercise form (students create their own body concepts and assembly designs under supervision)
Assessment method:	written examination or term paper
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	basic knowledge from the modules of Materials Science, Mechanics (STK, ES, KI, SW) and Production Engineering/Logistics Please observe examination regulations §24(8).
Mandatory requirements:	none

Recommended reading:	A constantly updated, detailed literature list will be provided at the beginning of the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 4, 2021

5.27 Vehicle Sensors

Module number:	2340
Module title in German:	Fahrzeugsensoren
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr. rer. nat. Edwin Kamau
Lecturer:	Prof. Dr. rer. nat. Edwin Kamau
Learning outcome:	Students will be able to create a sensor concept for a vehicle, in which they, • analyze the vehicle type and the application, • define relevant metrics, • select suitable sensors, taking into account the measuring principles of these sensors in order to later be able to design sensor concepts for different vehicle types and integrate them into the vehicle.
Module content:	Overview of sensors, sensor types and relevant actuators: basic properties, general characteristics, structure (microscopic / macroscopic), operating principles (mechanical, optical, electrical, acoustic, etc.) features to measure displacement, angle, speed, velocity, yaw rate, acceleration, flow, force, moments, pressure, current, temperature, gas, concentration, etc., sensor integration, automotive sensor designs and bus systems electrical actuators and vehicle integration
Teaching and learning methods:	• media-supported on-site teaching (lecture) with digital provision of study-related learning material via intranet-based learning platform • facilitation of the application of solution methods to typical, practice-oriented tasks
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Physics, Electrical engineering, Vehicle Electrics and Electronics, Engineering Mathematics 1-3
Mandatory requirements:	none
Recommended reading:	will be provided at the beginning of the lecture
Use of the module in other degree programs:	none
Special features:	none
Last update:	June 8, 2022

5.28 Vehicle Safety

Module number:	5160
Module title in German:	Fahrzeugsicherheit
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the summer semester
Module responsible:	A. Sprenger
Lecturer:	A. Sprenger
Learning outcome:	The students will be able to • name the requirements of the legislator for the safety of vehicles, • describe the basic rules and requirements of vehicle registration and approval
Module content:	• development and definition of vehicle classes • requirements of the legislator for vehicle safety • requirements for vehicle type approval • §19.2/ §19.3 StVZO Einzelabnahmen (individual approvals)
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups (application examples)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	lecture script Further literature will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	June 8, 2022

5.29 Manufacturing Processes

Module number:	2330
Module title in German:	Fertigungsverfahren
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	1st
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. Christoph Hartl
Lecturer:	Prof. Dr.-Ing. Christoph Hartl
Learning outcome:	The students will be able to • make a suitable process selection for a manufacturing task from the industrial vehicle production, by • applying the knowledge imparted on the technical process options and the relationships between production processes and the factors of cost, time and quality, to • be able to decide on economically viable manufacturing processes in areas of employment such as product development, production or production planning.
Module content:	application-relevant fundamentals of industrially used manufacturing processes for part production and machining of components made of metallic materials, plastics, ceramics and glasses: original forming processes, forming processes, separating processes, coating processes, generative manufacturing.
Teaching and learning methods:	on-site teaching (lecture) with digital provision of learning material via intranet-based learning platform; guided solution of tasks on practical case studies
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	basic knowledge from the modules Materials Science, Technical Mechanics, Physics, Mathematics.
Mandatory requirements:	none
Recommended reading:	Fritz, A. H. u. a.: Fertigungstechnik, Berlin u. a., Springer Vieweg, 2018 Westkämper, E./Warnecke, H.-J.: Einführung in die Fertigungstechnik, Stuttgart u. a., Teubner Verlag, 2010. Further literature will be provided in the lecture according to the subject matter.
Use of the module in other degree programs:	B. Eng. Production and Logistics
Special features:	none
Last update:	October 20, 2021

5.30 Computer Science

Module number:	1040
Module title in German:	Informatik
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	1st
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. R. Jendges
Lecturer:	Prof. Dr.-Ing. R. Jendges
Learning outcome:	The students will be able to • name the basic terms of software engineering and programming, • recognize data types, data structures and control structures, • execute the principles of modularized programming, • use program libraries, • develop their own programs, functions and macros, • basically use the C programming language.
Module content:	• data types • operators and expressions • control structures • functions • preprocessor • vectors and pointers • library functions
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups (design exercises) • independent practical training in small groups
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	*Goll & Bröckl & Dausmann:* C als erste Programmiersprache, Teubner, 2003
Use of the module in other degree programs:	none
Special features:	none
Last update:	October 20, 2021

5.31 Computer Science in Vehicle Systems

Module number:	
Module title in German:	Informatik in Fahrzeugsystemen
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students can formally describe algorithms and know basic data structures by • applying different schemes for the design of algorithms and • analyzing different algorithms for searching and sorting in order to later be able to independently develop algorithms and data structures for specific vehicle technology problems.
Module content:	• overview of algorithm design and analysis • introduction to Phyton • algorithms for searching and sorting • data structures • representation of algorithms (runs, shortest paths, minimum spanning trees)
Teaching and learning methods:	on-site lecture exercises in small groups practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module in Computer Science
Mandatory requirements:	none
Recommended reading:	Mano, Kime: Logic and Computer Design Fundamentals, Pearson Verlag Flik: Mikroprozessortechnik und Rechnerstrukturen, Springer-Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	December 2, 2021

5.32 Engineering Mathematics 1

Module number:	1010
Module title in German:	Ingenieurmathematik 1
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	1st
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. rer. nat. M. Ruschitzka
Lecturer:	Prof. Dr. rer. nat. M. Ruschitzka, Dipl.-Ing. (FH) F. Richter, M.Sc.
Learning outcome:	The students • know the basic mathematical methods and procedures used in engineering in general and in automotive engineering in particular, and can reproduce, interpret and perform them, • are able to present, formulate and design the application reference of the presented methods and procedures with examples especially from automotive engineering, • can describe, formulate and elaborate mathematical models using basic mathematics, • know the basic possibilities of using computers with numerical (Scilab or Matlab) or computational algebraic (Maple) methods to develop, analyze and calculate mathematical models.
Module content:	• Basic knowledge: number sets, equations and inequalities, powers, logarithms, elementary functions • vectors in 3-dim. Room: vector algebra, coordinate representation, scalar product, vector product with determinants, spar product, geometric applications • Linear - systems of equations: Gauss algorithm, Cramer's rule, geometric interpretation • Differential calculus of real functions with one real variable: sequences, functions and their properties, function limits, continuity, differentiability, curve discussion, standard functions • Introduction to the integral calculus of real functions of a real variable: Riemann integral, integration rules and methods
Teaching and learning methods:	• self-study through digital teaching materials on the ILIAS learning platform • seminars for discussion and consolidation (online or on-site) • exercises in small groups • weekly task sheets
Assessment method:	oral exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	Mathematics of 10th grade at “Gymnasium”, basic knowledge of vector calculus and analysis, if necessary, attendance of a mathematics pre-course or the online mathematics bridge course OMB+

Mandatory requirements:	none
Recommended reading:	• *L. Papula:* Mathematik für Ingenieure, Bd. 1, Vieweg • *Th. Rießinger:* Mathematik für Ingenieure, Springer-Verlag
Use of the module in other degree programs:	The module is also offered under the name Mathematics I in the Bachelor's degree program Production and Logistics.
Special features:	none
Last update:	November 23, 2021

5.33 Engineering Mathematics 2

Module number:	1020
Module title in German:	Ingenieurmathematik 2
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	2nd
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. R. Jendges
Lecturer:	Prof. Dr.-Ing. R. Jendges,
Learning outcome:	The students • know the basic mathematical methods and procedures used in engineering in general and in automotive engineering in particular, and can reproduce, interpret and perform them, • are able to present, formulate and design the application reference of the presented methods and procedures with examples especially from automotive engineering, • can describe, formulate and elaborate mathematical models using basic mathematics, • are able to independently use the possibility of computer application with numerical (Scilab or Matlab) or computer algebraic (Maple) methods to solve mathematical models in order to analyze and calculate them.
Module content:	• consolidation of the differential calculus of real functions of a real variable: e.g. basic concepts of differential geometry • consolidation of the integral calculus of real functions of a real variable: especially applications • Linear algebra: vector spaces, matrix calculus, determinants, linear systems of equations, eigenvalues • Complex numbers: representations, calculation rules, complex-valued functions
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups (calculation exercises) • independent practical training in small groups including presentation • technical discussion (individual)
Assessment method:	written examination, oral examination if necessary
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	Mathematics 10th grade at “Gymnasium”, basic knowledge of vector calculus and analysis, if necessary, attendance of a mathematics pre-course or the online mathematics bridge course OMB+
Mandatory requirements:	none
Recommended reading:	• *L. Papula:* Mathematik für Ingenieure, Bd. 1 und Bd. 2, Vieweg • *Th. Rießinger:* Mathematik für Ingenieure, Springer-Verlag

Use of the module in other degree programs:	The module is also offered under the name Mathematics II in the Bachelor's degree program Production and Logistics.
Special features:	none
Last update:	November 11, 2019

5.34 Engineering Mathematics 3

Module number:	1030
Module title in German:	Ingenieurmathematik 3
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. rer. nat. M. Ruschitzka,
Lecturer:	Prof. Dr. rer. nat. M. Ruschitzka
Learning outcome:	The students • know the basic mathematical methods and procedures used in engineering in general and in automotive engineering in particular, and can reproduce, interpret and perform them, • are able to present, formulate and design the application reference of the presented methods and procedures with examples especially from automotive engineering, • can describe, formulate and elaborate mathematical models using basic mathematics, • are able to independently use the possibility of computer application with numerical (Scilab or Matlab) or computer algebraic (Maple) methods to solve mathematical models in order to analyze and calculate them.
Module content:	• Introduction to the analysis of real functions of several variables: differential and integral calculus • function series and integral transformations: especially Taylor and Fourier series, Fourier transformations • Ordinary differential equations: initial value tasks, solution procedure
Teaching and learning methods:	• self-study through digital teaching materials on the ILIAS learning platform • seminars for discussion and consolidation (online or on-site) • exercises in small groups • weekly task sheets
Assessment method:	oral exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	basic knowledge from Engineering Mathematics 1 and Engineering Mathematics 2
Mandatory requirements:	none
Recommended reading:	• *L. Papula:* Mathematik für Ingenieure, Bd. 1 und Bd. 2, Vieweg • *Th. Rießinger:* Mathematik für Ingenieure, Springer-Verlag
Use of the module in other degree programs:	The module is also offered as an elective module under the name Mathematics III in the Bachelor's degree program Production and Logistics.
Special features:	none
Last update:	November 23, 2021

5.35 Interdisciplinary Qualification

Module number:	
Module title in German:	Interdisziplinäre Qualifikation
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	variable
Recommended semester:	7th
Frequency:	winter and summer semester
Module responsible:	Prof. Dr.-Ing. J. Blaurock
Lecturer:	employees of the Competence Workshop and the Language Learning Center
Learning outcome:	The students improve their • ability to communicate and present, • ability of self, time and learning management, • ability to work in intercultural teams, • language skills.
Module content:	Students take ECTS-eligible courses from the current internal university program of the Academy for Continuing Academic Education on the following overarching topics: • communication and presentation • working and learning in organizations • intercultural training • language
Teaching and learning methods:	• seminars • workshops
Assessment method:	depends on the chosen course
Workload: (25 - 30h ≙ 1 ECTS credit) :	*150h* *The total of courses taken must add up to at least 5 ECTS.*
Contact hours:	depends on the chosen course
Self-study:	depends on the chosen course
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	will be specified in the respective seminar or workshop
Use of the module in other degree programs:	none
Special features:	none
Last update:	June 8, 2022

5.36 Artificial Intelligence

Module number:	
Module title in German:	Künstliche Intelligenz
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th
Frequency:	once a year in the summer semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students will be familiar with the most important AI methods and their application in vehicle technology practice, by • applying various problem solving, search and planning algorithms, • analyzing common estimation methods (Bayes, Demster/Shafer, fuzzy inference) according to their advantages and disadvantages and • discussing possible dangers posed by artificial intelligence in order to be able to later evaluate the use of artificial intelligence and independently select suitable algorithms.
Module content:	• introduction to AI systems • AI programming languages • formalization and preparation of problems • practical application of artificial intelligence • AI systems in automotive engineering • ethical aspects
Teaching and learning methods:	on-site lecture exercises in small groups practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	modules Mathematics 1 to 3 and Computer Science
Mandatory requirements:	none
Recommended reading:	Ertl: Grundkurs Künstliche Intelligenz: Eine praxisorientierte Einführung, Springer-Verlag Lämmel, Cleve: Lehr- und Übungsbuch Künstliche Intelligenz, Carl Hanser Verlag Nolting: Künstliche Intelligenz in der Automobilindustrie: Mit KI und Daten vom Blechbieger zum Techgiganten, Springer-Verlag Folkers: Steuerung eines autonomen Fahrzeugs durch Deep Reinforcment Learning, Springer-Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 17, 2021

5.37 Lightweight Construction / FEM

Module number:	5118
Module title in German:	Leichtbau / FEM
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Prof. Dr.-Ing. F. Herrmann
Lecturer:	Prof. Dr.-Ing. F. Herrmann
Learning outcome:	The students will be able to • explain and apply the mechanical, elastokinematic basis needed for the basic understanding of the FE method, • use a commercial FEM program for basic, mechanical lightweight design issues, • fully analyze the mechanical stress condition in the studied assembly based on the results and perform design optimization, • perform first simple nonlinear FEM analyses.
Module content:	• explanation of the basic principle of FEM based on the matrix stiffness method (theory and derivation of a beam example) • overview of features of commercial FEM programs • introduction to the operation of the commercial FEM program ABAQUS • model development (elements, material, boundary conditions, solution methods) for linear and nonlinear stress analyses • independent development of FEM solutions for lightweight design problems in the field of car body structures
Teaching and learning methods:	• lecture • PC-based project work
Assessment method:	performance examination or term paper
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Basic knowledge from the modules of Materials Science, Mechanics and Mathematics.
Mandatory requirements:	none
Recommended reading:	none
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 4, 2021

5.38 Machine Elements 1

Module number:	2050
Module title in German:	Maschinenelemente 1
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. Axel Faßbender
Lecturer:	Prof. Dr. Axel Faßbender
Learning outcome:	The students are able to use technical terms and describe mechanisms of action in the context of the machine elements dealt with in order to then be able to carry out and evaluate simple design tasks, such as pre-dimensioning, strength checks or designs, using the basic calculation methods.
Module content:	tolerances, tribology, strength verification according to the FKM guideline, rolling bearings, plain bearings, bearing arrangements, axles and shafts, seals, shaft-hub connections, springs
Teaching and learning methods:	Teaching method: mixture of face-to-face teaching, digi-vote, blended learning Learning method: interactive e-book with exercises, learning videos
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	50h
Self-study:	100h
Recommended prerequisites:	Technical Drawing, Materials Science 1 and 2, Manufacturing Processes, Technical Mechanics 1 and 2, Physics
Mandatory requirements:	none

Recommended reading:	BLAUROCK, Jochen und Axel FAßBENDER, 2021. Interaktiver Grundkurs *Maschinenelemente,* Band 1. München: Hanser. ISBN 978-3-446-46232-8 Available on: https://www.hanser-elibrary.com/doi/10.3139/9783446462328 WITTEL, Herbert, Christian SPURA and Dieter JANNASCH, 2021. Roloff/Matek Maschinenelemente: Normung, Berechnung, Gestaltung *[online].* 25th ed. 2021. Wiesbaden: Springer Fachmedien Wiesbaden, Imprint; Springer Vieweg. ISBN 978-3-658-34160-2. Available at: https://doi.org/10.1007/978-3-658-34160-2 RIEG, Frank, Frank WEIDERMANN, Gerhard ENGELKEN, Reinhard HACKENSCHMIDT and Bettina ALBER-LAUKANT, 2018. Decker: Maschinenelemente: Funktion, Gestaltung und Berechnung *[online]*, 20th newly revised edition 2018. München: Hanser Verlag. ISBN 978-3-446-45304-3. Available at: https://www.hanser-elibrary.com/doi/10.3139/9783446453043
Use of the module in other degree programs:	none
Special features:	none
Last update:	May 16, 2022

5.39 Machine Elements 2

Module number:	2060
Module title in German:	Maschinenelemente 2
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr. Axel Faßbender
Lecturer:	Prof. Dr. Axel Faßbender
Learning outcome:	The students are able to use technical terms and describe mechanisms of action in the context of the machine elements dealt with in order to then be able to perform and evaluate simple design tasks, such as pre-dimensioning, strength checks or designs, in an action-oriented manner using the basic calculation methods.
Module content:	Connections: gluing, soldering, welding, screwing Gear means: belts, chains, gears Transmission: fundamentals
Teaching and learning methods:	project-based teaching, impulse lectures, learning videos, learning coaching
Assessment method:	individual work (connections, constructive design of a gearbox)
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	50h
Self-study:	100h
Recommended prerequisites:	Technical Drawing, CAD, Materials Science 1 and 2, Manufacturing Processes, Technical Mechanics 1 and 2, Physics, Machine Elements
Mandatory requirements:	none

Recommended reading:	WITTEL, Herbert, Christian SPURA and Dieter JANNASCH, 2021. Roloff/Matek Maschinenelemente: Normung, Berechnung, Gestaltung *[online].* 25th ed. 2021. Wiesbaden: Springer Fachmedien Wiesbaden, Imprint; Springer Vieweg. ISBN 978-3-658-34160-2. Available at: https://doi.org/10.1007/978-3-658-34160-2 RIEG, Frank, Frank WEIDERMANN, Gerhard ENGELKEN, Reinhard HACK-ENSCHMIDT and Bettina ALBER-LAUKANT, 2018. Decker: Maschinenelemente: Funktion, Gestaltung und Berechnung *[online]*, 20th newly revised edition 2018. München: Hanser Verlag. ISBN 978-3-446-45304-3. Available at: https://www.hanser-elibrary.com/doi/10.3139/9783446453043
Use of the module in other degree programs:	none
Special features:	none
Last update:	May 16, 2022

5.40 Mechatronic Vehicle Systems

Module number:	3060
Module title in German:	Mechatronische Fahrzeugsysteme
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Dr. Farshizadeh
Lecturer:	Dr. Farshizadeh
Learning outcome:	The students will be able to • describe the mode of action, the structure and the components of the • most important vehicle systems, • explain the mechatronic development cycle and • perform it on practical problems, • exemplarily describe the steps model building, analysis and • synthesis to be applied in the development of vehicle systems.
Module content:	• introduction to vehicle systems of longitudinal, lateral and vertical dynamics, • actuators, sensors, bus systems and control units, electrical wiring system • modeling of vehicle systems • control engineering analysis of vehicle systems • implementations of regulations • digital simulation • • functional safety
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups (self-computation exercise under supervision) • independent practical training in teams of 3 students • (simulation-based tasks on current topics) • • blended learning
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	96 h
Self-study:	54 h
Recommended prerequisites:	basic knowledge of Control Engineering, Electrical Engineering, Hydraulics basic knowledge of the software Matlab Simulink
Mandatory requirements:	none
Recommended reading:	Roddeck: Einführung in die Mechatronik, Teubner Verlag Isermann: Mechatronische Systeme, Grundlagen, Springer-Verlag Heimann/Gerth/Popp: Mechatronik, Fachbuchverlag Leipzig Schiessle: Mechatronik 1/2 Vogel Robert Bosch GmbH: Sicherheits- und Komfortsysteme,.Vieweg + Teubner Verlag
Use of the module in other degree programs:	none
Special features:	none

Last update: October 20, 2021

5.41 Commercial Vehicle Technology

Module number:	5110
Module title in German:	Nutzfahrzeugtechnik
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the summer semester
Module responsible:	H. Gees
Lecturer:	H. Gees
Learning outcome:	The students will be able to • explain the legal requirements for the design of a commercial vehicle in terms of masses and lengths, • classify commercial vehicle types and assign the requirements for a type class, • determine vehicle dynamics variables on a commercial vehicle or can estimate the influence of conceptual changes on these variables, • describe the properties of components specific to commercial vehicles, • define interfaces between chassis and body.
Module content:	• legal basis • history • typology • driving mechanics of the commercial vehicle • component knowledge (frame, axles, cab, drive, brake)
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups or individually (calculation exercises) • project work in small groups • technical discussion (individual)
Assessment method:	term paper
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Basic knowledge from the modules Technical Mechancis 1-3, Machine Elements as well as Driving Mechanics.
Mandatory requirements:	none
Recommended reading:	*Hoepke, E.; Breuer, S.:* Nutzfahrzeugtechnik, 4th edition, Vieweg-Verlag Grundlagen der Nutzfahrzeugtechnik, Kirschbaum-Verlag *Braun, H.; Kolb, G.:* LKW - Ein Lehrbuch und Nachschlagewerk, Kirschbaum-Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 17, 2021

5.42 Surface and Coating Technology

Module number:	5280
Module title in German:	Oberflächen- und Schichttechnologie
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. J. Stollenwerk
Lecturer:	Prof. Dr. J. Stollenwerk
Learning outcome:	The students will • be able to explain the most important terms of vacuum technology (pressure ranges, vapor pressure, concept of mean free path) and plasma physics by assigning them to the different types of discharge in order to later be able to technically design a deposition system, • know the multitude of deposition techniques available on the market (magnetron sputtering, arc processes, etc.) by being able to classify them according to CVD and PVD processes and thus later being able to select a suitable process for a given application, • know the requirements for technically relevant components in automotive engineering (wear and corrosion protection, transparent conductors, metallizations, thermal insulation glazing) by presenting the most important properties of the individual films such as layer thickness, material, hardness and stoichiometry in order to be able to define the required product later in the form of a coating system.
Module content:	Lecture: basics of vacuum and plasma technology Fields of application of surface and coating technologies in automotive engineering: • engine (injectors, pistons and cylinder bore surfaces) • gears (low-friction coatings for tribological applications) • plain bearing • corrosion and wear protection • glass coatings (rear, front and side windows, dashboard, rear view mirrors) • headlight metallization • plastic bumper Practical training: • generation of a high vacuum by turbomolecular pumping unit • recording of the current-voltage characteristic of a magnetron discharge • deposition of titanium and titanium nitride by magnetron sputtering technique
Teaching and learning methods:	• classroom teaching (lecture and exercise) • vacuum technology and plasma technology demonstrations • practical training with preparation of a protocol in small groups • presentation of results of the practical training
Assessment method:	term paper or written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	56h

Self-study:	94h
Recommended prerequisites:	Physics completed with good or very good results
Mandatory requirements:	none
Recommended reading:	*Frey, H.:* Vakuumbeschichtung Bd.1 - 5, VDI-Verlag, Düsseldorf (1993) *Erkens et.al.:* Plasmagestützte Oberflächenbeschichtung, Verlag Moderne Industrie, München (2010) Further literature will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 4, 2021

5.43 Physics

Module number:	1050
Module title in German:	Physics
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	1st
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. J. Stollenwerk
Lecturer:	Prof. Dr. J. Stollenwerk, Dr. A. Hilger
Learning outcome:	The students • recognize the different types of error sources and are able to perform an error calculation by creating a graphical application and performing a linear regression in order to later indicate a result documentation with significant digits only. • • are able to give a kinetic and dynamic description for simple mechanical systems with linear motion and rotation by setting up the balance equations for the law of conservation of energy and momentum as well as the equilibrium of forces in order to be able to draw conclusions about the mechanical behavior later.
Module content:	Lecture: 1.) working principle of physics, basics of error calculation 2.) Concept of mechanics for linear and rotary motion as the basis of physics: - classification of a movement: speed and acceleration - force and moment concept, - mass and moment of inertia, - Newton's axioms - energy and momentum 3.) Superordinate principles of the fields of mechanics, acoustics, thermodynamics, optics, electricity and magnetism: - balances of forces - conservation of energy and momentum - vibrations and waves 4.) Implications for automotive applications: - electromobility - autonomous driving Practical training: 2 experiments from the subject areas: - determination of the acceleration due to gravity by means of a mathematical pendulum, formation of mean value and standard deviation, linear error propagation - measurement of spring constants with static and dynamic method, linearization and plotting of measured values, linear regression
Teaching and learning methods:	• on-site teaching (lecture with demonstration experiments, seminar-based teaching with discussion) • preparation of the exercise in small groups as homework, discussion of student solutions in small groups • independent practical work in small groups with protocol preparation incl. error calculation, final discussion about results

Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	74h
Self-study:	76h
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	*Vorlesungsskript* *Tipler:* Physik, Spektrum Akademischer Verlag, Heidelberg *Meschede*, *Gerthsen:* Physik, Springer Verlag, Berlin *Lindner:* Physik für Ingenieure, Vieweg Verlag, Braunschweig Further literature will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	May 16, 2022

5.44 Passenger Car Hydraulics

Module number:	5282
Module title in German:	Pkw-Hydraulik
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4/5
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr. Axel Faßbender
Lecturer:	Prof. Dr. Axel Faßbender
Learning outcome:	Students will be able to describe the basic hydraulic relationships and apply them to hydraulic car components in order to be able to carry out basic pre-dimensioning with regard to functional and energy aspects in the context of hydraulic circuits.
Module content:	symbols, physical/hydraulic basics, pressure media, hydraulic components in passenger cars: pumps, valves, hydraulic motors, hydraulic accumulators, hydraulic applications in passenger cars: steering, brakes, vibration damping, active chassis systems, transmission, engine, battery cooling.
Teaching and learning methods:	on-site teaching with lecture and small group exercises
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	50h
Self-study:	100h
Recommended prerequisites:	Technical Drawing, Machine Elements 1, Machine Elements 2, Physics
Mandatory requirements:	none

Recommended reading:	MURRENHOFF, Hubertus und Katharina SCHMITZ, 2018. Grundlagen der Fludtechnik: Teil 1: Hydraulik. Shaker Verlag. ISBN: 978-3-8440-6246-5 GROLLIUS, Horst-W., 2022. Grundlagen der Hydraulik. Hanser. ISBN: 978-3-446-47404-8 Available at https://www.hanser-elibrary.com/doi/10.3139/9783446474048
Use of the module in other degree programs:	none
Special features:	none
Last update:	May 26, 2022

5.45 Practical Engineering Semester

Module number:	940
Module title in German:	Ingenieurpraktisches Semester
Module type:	mandatory
ECTS credits:	28
Language:	German
Module duration:	22 weeks
Recommended semester:	6th
Frequency:	in the winter and summer semester
Module responsible:	Prof. Dr. rer. nat. habil. Rainer Lenz
Lecturer:	
Learning outcome:	Students are able to apply the specialized knowledge acquired during their studies to concrete tasks in a problem-oriented manner and bring about solutions by classifying, (critically) evaluating and processing practical engineering-related topics in a team in order to be able to solve complex tasks in a problem-oriented manner later in their working lives and to document and justify the results in a comprehensible manner.
Module content:	• engineering activity, usually industrial, in the field of automotive engineering (see teaching methods) as well as in higher education • Contents are specified by the respective employer.
Teaching and learning methods:	Internship in a company in the automotive industry, its suppliers, in the field of expert witnesses, aerospace engineering, general mechanical engineering, plant and power plant construction and, in exceptional cases, in other engineering disciplines (mechatronics, electrical engineering and civil engineering) in which mechanical engineering issues arise.
Assessment method:	internship report, 20-pages, submission of a 1-page employer's reference
Workload: (30 h ≙ 1 ECTS credit) :	840h 22 weeks full time
Contact hours:	
Self-study:	
Recommended prerequisites:	
Mandatory requirements:	According to the examination regulations for the Bachelor of Vehicle Development, the following is required for the practical semester: admitted upon application, who has passed at least nine module examinations of the first two semesters according to the study plan.
Recommended reading:	depends on the topic
Use of the module in other degree programs:	
Special features:	only credit points, no grading
Last update:	November 29, 2021

5.46 Control Engineering

Module number:	2320
Module title in German:	Regelungstechnik
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr. rer. nat. Edwin Kamau
Lecturer:	Prof. Dr. rer. nat. Edwin Kamau
Learning outcome:	Students will be able to design control systems by • analyzing control loops, • modeling technical structures in transfer functions, • applying methods of control loop analysis in the time and frequency domain, • sketching control engineering issues in a structured manner in active circuit diagrams, • setting controllers according to empirical setting rules, • investigating the stability of control loops, • using basic actuators and sensors with active principles in order to later be able to develop modern control processes for vehicles.
Module content:	• fundamentals of the control loop (elements, structural analysis, applications) • steady-state and dynamic behavior • description of transmission blocks in time and frequency domain • control and disturbance behavior of control loops • design of a control in the time domain
Teaching and learning methods:	• media-supported classroom teaching (lecture) with digital provision of study-related learning material via intranet-based learning platform • instruction for the application of solution methods to typical, practice-oriented tasks (exercise) • illustration of the learning material by computer-aided demonstrations and animations (Matlab/Simulink)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	Physics, Electrical Engineering, Vehicle Electrics and Electronics, Engineering Mathematics.1, 2 and 3
Mandatory requirements:	none
Recommended reading:	Heimann, B.: Mechatronik, Hanser Verlag, 2007 Czichos, H.: Mechatronik, Vieweg Verlag, 2008 An additional detailed literature review will be provided during the lecture.
Use of the module in other degree programs:	none

Special features:	none
Last update:	June 8, 2022

5.47 Expert Services 1

Module number:	5210
Module title in German:	Sachverständigenwesen 1
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	A. Sprenger
Lecturer:	A. Sprenger
Learning outcome:	The students • can understand and describe the contents of the periodic technical inspection of motor vehicles.
Module content:	• the expert in the official sovereign field • traffic law StVO • EU Directive 2014/45, §29 StVZO • Vehicle Registration Ordinance FZV
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups (practical examples / exercises)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	lecture script Further literature will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	The module is taught with 6 hours per week per semester in the 1st half of the semester.
Last update:	June 8, 2022

5.48 Expert Services 2

Module number:	5220
Module title in German:	Sachverständigenwesen 2
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	A. Sprenger
Lecturer:	A. Sprenger
Learning outcome:	The students • learn to prepare damage and value appraisals.
Module content:	• damage assessment according to liability insurance principles • motor vehicle damage and valuation • accident analysis and reconstruction
Teaching and learning methods:	• on-site teaching (lecture) • learning in small groups (practical examples / exercises)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	none
Mandatory requirements:	none
Recommended reading:	lecture script Further literature will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	The module is taught with 6 hours per week per semester in the 2nd half of the semester.
Last update:	June 8, 2022

5.49 Vibration Theory

Module number:	2040
Module title in German:	Schwingungslehre
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th
Frequency:	twice a year (winter and summer semester)
Module responsible:	Prof. Dr.-Ing. Ch. Kardelky
Lecturer:	Prof. Dr.-Ing. Ch. Kardelky
Learning outcome:	The students will be able to • define oscillations and analyze them in terms of basic concepts, • calculate homogeneous and inhomogeneous vibration differential • equations and adapt them to the initial and, if necessary, boundary conditions, • set up magnification functions • solve differential equations of vibration for different excitations (harmonic, periodic, arbitrary) and • explain the difference between solutions in the time and frequency domain.
Module content:	• relationship between basic mechanical laws and the theory of vibrations, • basic concepts, free oscillations, initial and, if necessary, boundary conditions, • dry friction, viscous damping, forced vibration, • Lagrange's equations 2nd type • oscillations with two degrees of freedom (free and forced)
Teaching and learning methods:	lecture and exercise
Assessment method:	written examination
Workload: (25 - 30 h ≙ 1 ECTS credit):	150h
Contact hours:	64h
Self-study:	86h
Recommended prerequisites:	Knowledge of differential equations and determinants, knowledge from Technical Mechanics 1 and 2
Mandatory requirements:	none
Recommended reading:	*Gross, Hauger, Schröder, Wall*: Technische Mechanik 3, Kinetik, Springer Verlag *Gross, Ehlers, Wriggers, Schröder, Müller*: Formeln und Aufgaben zur Technischen Mechanik 3, Kinetik und Hydrodynamik, Springer Vieweg Verlag Hagedorn et al.: Technische Schwingungslehre, Edition Harri Deutsch, Europa Lehrmittel *Hibbeler:* Technische Mechanik 3, Dynamik, Pearson Verlag *Jäger, Mastel, Knaebel*: Technische Schwingungslehre, Springer Vieweg Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 16, 2021

5.50 Simulation of Passenger Car Systems

Module number:	5297
Module title in German:	Simulation von Kfz-Systemen
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. R. Jendges
Lecturer:	Prof. Dr.-Ing. R. Jendges
Learning outcome:	The students • will know the essential features of commercial software tools for the simulation of vehicle systems, • can use appropriate simulation systems and interpret the simulation results, • are able to classify and evaluate solution methods for linear and non-linear problems, • can programmatically implement elementary solution methods for linear and nonlinear differential equation systems, • can name all engine components and describe their tasks.
Module content:	• vehicle relevant simulation programs (for MBS (Matlab, Adams, DSHPlus etc.) and continuous systems (Comsol, Abacus etc.)) • simulation problems and solution methods, classification, solution methods, iterative methods and relaxation methods, autonomous systems, oscillation problems • methods of model building real and computer models, physical and other systems, analytical/numerical models, discrete/continuous systems • program creation • simulation and verification
Teaching and learning methods:	
Assessment method:	oral exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	Engineering Mathematics 1 to 3
Mandatory requirements:	none
Recommended reading:	*Bratley, P.; Bennet, L.F.:* “A Guide to Simulation”, New York, Springer, 1987 *Hageman, L.A.; Young, D.M.:* „Applied Iterative Methods“, Dover Publications, 2004 *Hairer, E.; Wanner G.:* „Solving ODEs II, Stiff and Differential-Algebraic Problems“, Berlin, Springer, 2002
Use of the module in other degree programs:	none
Special features:	none

Last update: October 20, 2021

5.51 Student Research Project

Module number:	1630
Module title in German:	Studienarbeit
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	7th
Frequency:	twice a year in the winter and summer semester
Module responsible:	all lecturers of the Institute of Automotive Engineering
Lecturer:	all lecturers of the Institute of Automotive Engineering
Learning outcome:	The students • can apply the knowledge acquired in the course of study in a problem-oriented manner, • are able to acquire new knowledge independently, • can act purposefully, • are able to work independently and result-oriented within a fixed time frame.
Module content:	depends on the project topic
Teaching and learning methods:	individual work with minimal input from instructors (max. 0.4 hours per week per semester) students work independently on a specific task from the field of automotive engineering
Assessment method:	project work
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	
Self-study:	
Recommended prerequisites:	
Mandatory requirements:	
Recommended reading:	depending on project topic
Use of the module in other degree programs:	
Special features:	
Last update:	October 20, 2021

5.52 Technical Mechanics 1

Module number:	2410
Module title in German:	Technische Mechanik 1
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	1st
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. Jochen Blaurock
Lecturer:	Prof. Dr.-Ing. Jochen Blaurock
Learning outcome:	Students will be able to calculate static equilibria by • calculating with vectors and • thus analyzing the effect of forces and moments in statically determined force systems, to later dimension individual parts, assemblies and entire systems.
Module content:	• fundamentals • vectors in mechanics • force systems • main focus • equilibria • trusses • internal forces • liability • virtual work
Teaching and learning methods:	• on-site lecture • exercises in small groups • student tutorials
Assessment method:	written examination
Workload: (25 - 30 h ≙ 1 ECTS credit):	150h
Contact hours:	75h
Self-study:	75h
Recommended prerequisites:	• knowledge of Mathematics according to “Fachhochschulreife”, • spatial imagination
Mandatory requirements:	none
Recommended reading:	Blaurock, Faßbender: Interaktiver Grundkurs Technische Mechanik: Band 1, Carl Hanser Verlag Blaurock, Faßbender: Interaktive Aufgaben Technische Mechanik: Band 1, Carl Hanser Verlag Spura: Technische Mechanik 1 Stereostatik, Springer Verlag Mahnken: Lehrbuch der Technischen Mechanik – Band 1: Starrkörperstatik, Springer-Verlag
Use of the module in other degree programs:	B. Eng. Production and Logistics
Special features:	none

Last update: November 17, 2021

5.53 Technical Mechanics 2

Module number:	2420
Module title in German:	Technische Mechanik 2
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	2nd
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. Ch. Kardelky
Lecturer:	Prof. Dr.-Ing. Ch. Kardelky
Learning outcome:	The students • know the definition of voltage and can transform given voltages in different directions, • know the concept of distortion and the connection with tensions, • can calculate the resulting stress from each internal forces, • know how the stresses are distributed across the cross section, • can integrate the differential equation(s) of the bending line, • are able to calculate deformations, • can analyze a system in terms of its stability.
Module content:	• definition and limits of Technical Mechanics II (TM II) • interaction with the module Technical Mechanics I (TM I) • stress state, distortion state • elasticity law • normal stress, shear stress, bending stress • deformations due to bending (and normal force) • shear force, shear and shear deformation • torsion and deformation due to torsion • stability problems
Teaching and learning methods:	lecture and exercise
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	knowledge of Mathematics according to “Fachhochschulreife”, knowledge from Technical Mechanics 1
Mandatory requirements:	none
Recommended reading:	Gross, Hauger, Schröder, Wall: Technische Mechanik 2, Elastostatik, Springer Verlag Gross, Ehlers, Wriggers, Schröder, Müller: Formeln und Aufgaben zur Technischen Mechanik 2, Elastostatik und Hydrostatik, Springer Verlag Hagedorn, Wallaschek: Technische Mechanik, Bd. 2: Festigkeitslehre, Europa Lehrmittel Verlag Hibbeler: Technische Mechanik 2, Festigkeitslehre, Pearson Verlag Wriggers et al.: Technische Mechanik kompakt, Teubner Verlag (Springer Vieweg)

Use of the module in other degree programs:	ıone
Special features:	ıone
Last update:	Jovember 16, 2021

5.54 Technical Mechanics 3

Module number:	2430
Module title in German:	Technische Mechanik 3
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. Ch. Kardelky
Lecturer:	Prof. Dr.-Ing. Ch. Kardelky
Learning outcome:	The students • can explain the difference between kinematics and kinetics, • can analyze kinematic relationships, apply them to concrete tasks and determine an instantaneous pole, • are able to determine degrees of freedom of simple systems, • can describe and apply relationships between force and displacement, mass and velocity, or moment and angle, moment of inertia and angular acceleration (momentum theorem, angular momentum theorem, energy theorem, work theorem) • can analyze combined translational-rotational problems.
Module content:	• definition of Technical Mechanics III (TM III), • kinematics of a mass point (temporal relationship between location, velocity and acceleration): basic kinematic tasks • motion in Cartesian, polar and natural coordinates • kinetics of the point of mass (oblique throw, guided motion, momentum theorem, angular momentum theorem, energy theorem, work and work theorem) • lkinematics and kinetics of a rigid body, relative motion
Teaching and learning methods:	lecture and exercise
Assessment method:	written examination
Workload: (25 - 30 h ≙ 1 ECTS credit):	150h
Contact hours:	80h
Self-study:	70h
Recommended prerequisites:	knowledge of Mathematics from the modules on Engineering Mathematics, knowledge from Technical Mechanics 1 and 2
Mandatory requirements:	none
Recommended reading:	*Gross, Hauger, Schröder, Wall*: Technische Mechanik 3, Kinetik, Springer Verlag *Gross, Ehlers, Wriggers, Schröder, Müller*: Formeln und Aufgaben zur Technischen Mechanik 3, Kinetik und Hydrodynamik, Springer Verlag *Hagedorn, Wallaschek*: Technische Mechanik, Bd. 3: Dynamik, Ed. Harri Deutsch, Europa Lehrmittel *Hibbeler*: Technische Mechanik 3, Dynamik, Pearson Verlag *Wriggers et al.:* Technische Mechanik kompakt, Teubner Verlag (Springer Vieweg)
Use of the module in other degree programs:	none

Special features:	none
Last update:	November 16, 2021

5.55 Thermodynamics and Fluid Mechanics

Module number:	2130
Module title in German:	Thermodynamik und Strömungsmechanik
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	3rd
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. K.-U. Münch
Lecturer:	Prof. Dr.-Ing. K.-U. Münch
Learning outcome:	The students are able to • explain the basic concepts of thermo- and fluid mechanics, • describe the basic calculation methods and apply them to concrete tasks, • describe thermodynamic and fluidic systems from the vehicle, • perform a basic design of thermodynamic and fluidic systems.
Module content:	• state variables and equations of ideal and real gases • first and second law of thermodynamics (temperature as a state variable, conservation of energy, quantitative detection of irreversibilities) • changes of state of pure substances • application of the first law to cyclic processes (heat engine, heat pump, refrigerating machine) • introduction to heat transfer • law of conservation of mass, energy (Bernoulli's equations) and momentum • fundamentals of frictional flow (boundary layer theory) • flow separation • fundamentals of automotive aerodynamics
Teaching and learning methods:	on-site teaching (lecture and exercise) with practical test
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	84 h
Self-study:	66h
Recommended prerequisites:	knowledge of Mathematics 1, 2 and Physics
Mandatory requirements:	none
Recommended reading:	*Gersten, K.:* Strömungsmechanik, Shaker Verlag, Aachen, 1997 Cerbe, G., Wilhelms, G.: Technische Thermodynamik, Hanser Verlag, 2021
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 25, 2021

5.56 Tribology and Automotive Operating Fluids

Module number:	5260
Module title in German:	Tribologie und Kraftfahrzeug-Betriebsstoffe
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year in the winter semester
Module responsible:	M. Winkler
Lecturer:	M. Winkler
Learning outcome:	The students are able to • name and explain the basic terms of tribology, • explain the structure and properties of the lubricants, fuels and coolants used in motor vehicles, • name the relevant classifications and specifications of operating materials, • assess the toxicological impact of the operating materials.
Module content:	• Fundamentals of tribology: friction and wear mechanisms • Viscosity and density: Newtonian and non-Newtonian fluids, kinematic and dynamic viscosity, dependencies of viscosity on temperature, pressure and shear rate, density behavior under influence of pressure and temperature • Petroleum: formation, deposits, mining, extraction, refining • Base oils for lubricants: types, production, properties, additives for lubricating and • Fuels: types and properties, test methods for lubricants: mechanical dynamic and analytical • Engine oils and gear oils: national and international classifications and specifications, company specifications and approvals, base oil selection and additivation, • Rolling bearing lubrication: service life calculations and estimates taking into account the lubricating oils and greases used • Greases: development, production, properties and applications of lubricating greases • Other lubricants: hydraulic oils for special units, refrigerating machines for air conditioning, other special products • Coolant: specifications and composition of coolants, manufacturer specifications • Fuels: gasoline, diesel and alternative fuels for motor vehicles, refining, properties, standardization, current developments • Toxicology: safety and disposal, safety data sheet, legislations and regulations • Special Topics in Tribology: EHD theory, lubricant film thickness calculations, wear calculations, special applications.
Teaching and learning methods:	• on-site teaching (lecture) • exercises • practical training

Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	basic knowledge of Physics, Materials Science, Chemistry, Machine Elements, Statics and Elastostatics
Mandatory requirements:	none
Recommended reading:	*Möller, U.J.; Nassar, J.:* Schmierstoffe im Betrieb, Springer Verlag, Berlin, 2002 Weiterführende Additional literature as well as standards, specifications and classifications will be provided in the lecture.
Use of the module in other degree programs:	none
Special features:	none
Last update:	January 6, 2020

5.57 Combustion Engines

Module number:	5126
Module title in German:	Verbrennungsmotoren
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th
Frequency:	twice a year in the winter and summer semester
Module responsible:	Prof. Dr.-Ing. R. Haas
Lecturer:	F. Mühler
Learning outcome:	The students are able to • describe the processes in the internal combustion engine from combustion to pressure buildup, • explain the meaning of mean pressure and efficiencies, • name the limits of the efficiencies, • describe the process and the significance of the charge change, • analyze and interpret characteristic diagrams, • describe the most important properties of fuels, • describe and compare the operating principle and function of the most important mixture formers in the internal combustion engine.
Module content:	• in-depth fundamentals of internal combustion engines • motor thermodynamics • thermodynamics of combustion • efficiencies, medium pressure • pressure diagram • charge change • fuels • ignition • gasoline and diesel engine • mixture former gasoline and diesel engine
Teaching and learning methods:	• on-site teaching • practical training in small groups • technical discussion (individual)
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	48h
Self-study:	102h
Recommended prerequisites:	basic knowledge from the Modules of Physics, Materials Science, Thermodynamics and Fluid Mechanics, Engineering Mathematics, Electrical Engineering, Vehicle Electrics and Electronics, Machine Elements, Driving Mechanics as well as Vehicle Drivetrain
Mandatory requirements:	none

Recommended reading:	*Schäfer:* Handbuch Verbrennungsmotoren Bosch: Kraftfahrzeugtechnisches Taschenbuch *Grohe:* Otto- und Dieselmotoren *Küttner:* Kolbenmaschinen MTZ: Motortechnische Zeitschrift Bussien: Automobiltechnisches Handbuch
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 17, 2021

5.58 Connected Driving

Module number:	
Module title in German:	Vernetztes Fahren
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	once a year in the winter semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students will be able to identify and, if necessary, modify basic characteristics of fully networked vehicles by • encoding simple sensor signals on the CAN bus, • describing different input and output data and • identifying privacy issues, to later investigate and further develop connected vehicles in their digital infrastructure.
Module content:	• fundamentals of networking • networking in modern vehicles • digital infrastructure in vehicle environment • various bus systems • car-2-car and car-2-x communication • IT security and data protection
Teaching and learning methods:	• on-site lecture • exercises in small groups • practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	module in Computer Science
Mandatory requirements:	none
Recommended reading:	Mitteregger, et al.: Connected and Automated Driving: Prospects for Urban Europe, Springer-Verlag Reif: Bussysteme, Springer-Verlag Kotter: Datenschutz beim Vernetzten und Autonomen Fahren, Science Factory Holland: Dialogmarketing und Kundenbindung mit Connected Cars, Springer-Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 17, 2021

5.59 Virtual Product Development

Module number:	5240
Module title in German:	Virtuelle Produktentwicklung (VPE)
Module type:	elective
ECTS Credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	4th / 5th
Frequency:	once a year
Module responsible:	Prof. Dr.-Ing. Ch. Ruschitzka
Lecturer:	Prof. Dr.-Ing. Ch. Ruschitzka
Learning outcome:	Students understand the importance of the wide range of calculation and simulation methods for vehicle product development processes and can explain their benefits. They apply different software tools for virtual decision support (e.g.: kinematics, NC, FEM, topology optimization, casting simulation, CFD, virtual reality, CGI) to analyze the maturity of products. To this end, they can analyze problems, select suitable software tools to simulate the issue, and independently perform and evaluate simple simulations to analyze and evaluate the products.
Module content:	Knowledge transfer on the components of virtual product development: • visualization techniques, • finite element methods, • optimization methods, • NC simulation • CFD, • rapid prototyping • virtual reality and augmented reality in automotive engineering, • CAx interfaces Practical application of virtual methods: • kinematics simulation, • virtual manufacturing (NC simulation, assembly simulation, ...), • linear and non-linear FEM simulation • structure and topology optimization • casting simulation • application of VR systems with Powerwall and HMDs, • high-end visualization (CGI)
Teaching and learning methods:	lecture, practical training, project-based teaching

Assessment method:	term paper, practical exam, oral exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	120h
Self-study:	30h
Recommended prerequisites:	CAD, Advanced CAD
Mandatory requirements:	PC or laptop with current Windows operating system (64bit)
Recommended reading:	• Spur, Krause: Das virtuelle Produkt, Hanser Verlag • Martin Eigner, Radoslav Zafirov, Daniil Roubanov: Modellbasierte virtuelle Produktentwicklung, Springer Vieweg • Axel Schumacher: Optimierung mechanischer Strukturen, Springer Vieweg • Martin H. Rademacher: Virtual Reality in der Produktentwicklung: Instrumentarium zur Bewertung der Einsatzmöglichkeiten am Beispiel der Automobilindustrie, Springer Vieweg • Kamrani, Nasr: Rapid Prototyping - Theory and Practice, Springer Vieweg
Use of the module in other degree programs:	none
Special features:	digital synchronous lectures and practical training, asynchronous additional exercises
Last update:	May 10, 2022

5.60 Hydrogen Technology

Module number:	
Module title in German:	Wasserstofftechnik
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th
Frequency:	once a year in the winter semester
Module responsible:	TBD
Lecturer:	TBD
Learning outcome:	Students will be able to describe the advantages and disadvantages of using hydrogen as an energy carrier by • intensively discussing the various possible applications and • also analyzing the opportunities and risks of application, storage and economic and ecological impact, in order to later be able to plan the use of the technology with precision.
Module content:	• basics of hydrogen technology • functionality of fuel cells • hydrogen production • hydrogen storage • hydrogen refueling stations • ecological classification of hydrogen technology
Teaching and learning methods:	on-site lecture exercises in small groups practical training
Assessment method:	written examination
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	the modules Thermodynamics & Fluid Mechanics
Mandatory requirements:	none
Recommended reading:	Klell, Eichelseder, Trattner: Wasserstoff in der Fahrzeugtechnik, Springer Verlag Schmidt: Wasserstofftechnik, Hanser Verlag Lehmann, Luschtinetz: Wasserstoff und Brennstoffzellen: Unterwegs mit dem saubersten Kraftstoff der Welt, Springer Verlag
Use of the module in other degree programs:	none
Special features:	none
Last update:	November 16, 2021

5.61 Materials Science 1

Module number:	1070
Module title in German:	Werkstoffkunde 1
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	1st
Frequency:	once a year in the winter semester
Module responsible:	Prof. Dr.-Ing. P. Krug
Lecturer:	Prof. Dr.-Ing. P. Krug
Learning outcome:	The students • are able to describe the structure of metals and the essential mechanisms and properties in crystal lattices and justify how conditions and processes at the atomic level determine the macroscopic properties of materials in order to select a suitable material and material state from a limited number of materials for a given design. • know how to interpret state diagrams and explain the microstructural processes during forming and heat treatment in order to identify the most suitable process from a selection of heat treatment processes for given applications. • know the most important technological material testing methods, can apply them and interpret the test results appropriately in order to quantify significant parameters for a given constructive design.
Module content:	• fundamentals of atomic structure and materials science, bonding types and crystal structure, mass transport (diffusion), elastic behavior, plasticity, hardening mechanisms, phase diagrams, material groups, heat treatment, material testing methods, manufacturing processes
Teaching and learning methods:	• on-site teaching (lecture), exercises and tutorials for the independent application of the lecture material, experimental practicals, demonstration experiments, individual technical discussions.
Assessment method:	written examination (admission requirement for the written examination is that both intermediate tests offered are passed (with at least 30%) and that at least 50% of the points are achieved averaged over both intermediate tests.
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	45h
Self-study:	105h
Recommended prerequisites:	good knowledge in chemistry, physics; mathematics, spatial imagination
Mandatory requirements:	none
Recommended reading:	E. Macherauch / H.-W. Zoch: „Praktikum in Werkstoffkunde“, Vieweg Teubner Verlag Läpple; „Wärmebehandlung des Stahls“; Europa-Lehrmittel M. F. Ashby; D. R. H. Jones; „Werkstoffe 1“; Spektrum Akademischer Verlag M. F. Ashby; D. R. H. Jones; „Werkstoffe 2“, Spektrum Akademischer Verlag in English: M. F. Ashby; D. R. H. Jones; „Engineering Materials 1“, Butterworth-Heinemann

	M. F. Ashby; D. R. H. Jones; „Engineering Materials 2“,Butterworth-Heinemann
Use of the module in other degree programs:	The module is also offered in the degree program B. Eng. Production and Logistics.
Special features:	The results of the intermediate tests are added to the passed examination to improve the grade.
Last update:	November 22, 2021

5.62 Materials Science 2

Module number:	1080
Module title in German:	Werkstoffkunde 2
Module type:	mandatory
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	2nd
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. P. Krug
Lecturer:	Prof. Dr.-Ing. P. Krug
Learning outcome:	The students • carry out realistic development processes on selected vehicle construction components, their materials and manufacturing processes in a team-oriented project form in order to test different selection strategies with extensive parameter sets and target value conflicts. • plan and coordinate project-related tasks as part of a team using process flow diagrams to successfully implement comprehensive objectives within the specified time budget. • analyze and evaluate project-related literature by identifying different sources of information in order to critically compare relevant literature values with their own project results and to be able to evaluate them. • are able to make project results available across teams by documenting them in a digital form and in a structured manner in order to be able to communicate and present complex and extensive results in a targeted manner.
Module content:	• material-oriented development processes in the automotive and supplier industries, project-related processes in development teams, component-specific optimization strategies, cooperation between project teams working in parallel, targeted documentation and presentation of test results.
Teaching and learning methods:	• on-site teaching • colloquium before and during the experiment • project-related practical training in groups • presentations • technical discussion (individual)
Assessment method:	term paper
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	25h
Self-study:	125h
Recommended prerequisites:	Engineering Mathematics I; Engineering Mechanics I; Physics 1; good knowledge of chemistry, good spatial awareness, Materials Science I
Mandatory requirements:	
Recommended reading:	Läpple; „Wärmebehandlung des Stahls“; Europa-Lehrmittel M. F. Ashby; D. R. H. Jones; „Werkstoffe 1“; Spektrum Akademischer Verlag M. F. Ashby; D. R. H. Jones; „Werkstoffe 2“, Spektrum Akademischer Verlag in English: M. F. Ashby; D. R. H. Jones; „Engineering Materials 1“, Butterworth-Heinemann

	M. F. Ashby; D. R. H. Jones; „Engineering Materials 2“,Butterworth-Heinemann
Use of the module in other degree programs:	
Special features:	
Last update:	November 22, 2021

5.63 Materials Testing

Module number:	5200
Module title in German:	Werkstoffprüfung
Module type:	elective
ECTS credits:	5
Language:	German
Module duration:	one semester
Recommended semester:	5th semester
Frequency:	once a year in the summer semester
Module responsible:	Prof. Dr.-Ing. P. Krug
Lecturer:	Prof. Dr.-Ing. P. Krug
Learning outcome:	• The students • know the most important physical and technological material testing methods, can apply them and interpret the test results appropriately in order to quantify significant parameters for a given constructive design. • know the common methods of destructive (nzfP) and non-destructive (zfP) and are able to apply these methods, interpret the results and select the most suitable methods for a given application and justify this selection. • can identify the appropriate test methods for given, complex problems and compile the sequence of different tests in order to create test concepts for development, production or in the area of quality assurance. • can apply statistical methods, analyze and evaluate the recorded measured values with regard to their trustworthiness and informative value in order to compare, classify and evaluate results of larger test series or from different sources. • know the significance of relevant, international as well as national standards and can implement standard specifications in the field of materials testing in order to guarantee comparability of test results. • know standardized procedures for damage analysis in order to apply them to new problems.
Module content:	• Relationship between material structure and measurement possibilities or measured quantities, common methods of destructive and non-destructive materials testing in the automotive industry and its suppliers, assessment of test results, standardization and QA methods in materials testing, systematic assessment of damage cases.
Teaching and learning methods:	• on-site teaching • Practical training experiments • presentations (also in English) • Exercises in English • technical discussion (individual) • guest speakers
Assessment method:	oral exam
Workload: (25 - 30h ≙ 1 ECTS credit) :	150h
Contact hours:	60h
Self-study:	90h
Recommended prerequisites:	all compulsory modules in the field of engineering fundamentals
Mandatory requirements:	

Recommended reading:	B. Heine; „Werkstoffprüfung – Ermittlung der Eigenschaften metallischer Werkstoffe“, Carl Hanser Verlag. H.-J. Hunger; „Ausgewählte Untersuchungsverfahren in der Metallkunde“, Springer-Verlag E. Macherauch / H.-W. Zoch: „Praktikum in Werkstoffkunde“, Vieweg Teubner Verlag in English: Horst Czichos; "Springer Handbook of Materials Measurement Methods" (Springer Handbooks)
Use of the module in other degree programs:	This elective is also offered in the Production and Logistics degree program.
Special features:	
Last update:	November 4, 2021

5.64 Scientific Work 1 and 2

Module number:	
Module title in German:	Wissenschaftliches Arbeiten 1 und 2
Module type:	mandatory
ECTS credits:	5 (1st semester: 1 CP, 2nd semester: 1 CP, 7th semester: 3 CP)
Language:	German (if necessary partly English content/literature)
Module duration:	3 semesters
Recommended semester:	1st, 2nd and 7th semester
Frequency:	once in the academic year
Module responsible:	1st semester: Prof. Edwin Kamau; 2nd and 7th semester: TBD
Lecturer:	1st semester: Prof. Edwin Kamau; 2nd and 7th semester: TBD
Learning outcome:	The students • are able to plan a simple project in a team, • can independently carry out small project work, • present simple technical correlations, • know and name the importance of key competencies, • elaborate the essential rules of technical documentation, • present and document their work results in a professional way.
Module content:	• StartIng (WA 1a/BITs 1- Kick-Off: introductory session, • presentation and documentation of project-based technical content (BITs 1) • project work in small groups and presentation of results, • guidance and feedback sessions by pre-trained student tutors. • Review: feedback discussions on the course of the work processes in the groups. • Review: technical documentation by student tutors.
Teaching and learning methods:	project-based teaching and teamwork in small groups, kick-off, introductory session, exercises, competition, tutorial feedback, etc.
Assessment method:	Attendance-required courses (tests), written examination, oral examination, term paper
Workload: (25 - 30h ≙ 1 ECTS credit) :	1st semester: 30h, 2nd semester: 30h, 7th semester: 90h
Contact hours:	1st semester: 15h; 2nd semester: 15h; 7th semester: 45h
Self-study:	1st semester: 15h; 2nd semester: 15h; 7th semester: 45h
Recommended prerequisites:	MS Office (Word, Excel, Power Point), Citavi knowledge
Mandatory requirements:	none
Recommended reading:	M. Frantzen; M. Schnitzler.: Current handout for StartIng/WA Ib/BITs 1 module, M. Frantzen.: Recent Educational Product Development System Folding Map
Use of the module in other degree programs:	none
Special features:	WA 1 is carried out as "StartIng" together with BITs 1.
Last update:	November 25, 2021

6 Module matrix

Modulmatrix Teil 1: Profil **Studiengang: Fahrzeugentwicklung / SR Fahrzeugtechnik** **Fakultät 08**

Module / Lehrveranstaltungen				Handlungsfelder / Anzahl Kreditpunkte			Zuordnung Kompetenzen Absolvent*innenprofil							Zuordnung Studiengangkriterien			
Semester	Modul	Teilmodul/Lehrveranstaltung (optional)		82,50	62,50	64,00								Internationalisierung	Interdisziplinarität	Digitalisierung	Transfer
				ENT	ERP	HST	IGR	IAS	DIZ	CAE	VPD	HVA	PPL				
1	Wissenschaftliches Arbeiten 1	M1.1		0,00	1,00	0,00		X			X	X	X		X		X
2		M1.2		0,00	1,00	0,00		X			X	X	X		X		X
1	Digitalisierung (BITs)	M2.1	BITs1	1,00	0,00	0,00	X	X	X						X	X	
3		M2.2	BITs2	1,00	1,00	0,00	X	X	X						X	X	
5		M2.3	BITs3	1,00	1,00	0,00		X	X				X		X	X	
1	Fertigungstechnik			0,00	0,00	5,00			X		X	X		X	X	X	
1	Informatik			1,00	1,00	3,00		X	X	X				X	X	X	
1	Ingenieurmathematik 1			2,00	1,00	2,00	X	X								X	
1	Physik			2,00	2,00	1,00	X	X			X		X				
1	Technische Mechanik 1			4,00	0,50	0,50	X	X								X	
1	Werkstoffkunde 1			1,00	2,00	2,00	X				X	X	X	X	X		X
2	Betriebswirtschaftslehre			1,00	0,00	4,00						X	X	X	X		
2	Elektrotechnische Grundlagen			2,00	1,00	2,00	X	X								X	
2	Ingenieurmathematik 2			2,00	1,00	2,00	X	X								X	
2	Technische Mechanik 2			4,00	0,50	0,50	X	X									
2	Technisches Zeichnen			1,75	0,25	1,00	X	X	X	X						X	
2	Werkstoffkunde 2			1,00	2,00	2,00	X				X	X	X	X	X		X
3	CAD			1,75	0,25	1,00	X	X	X	X						X	
3	Fahrzeugelektrik und -elektronik			2,00	2,00	1,00	X	X		X					X	X	
3	Ingenieurmathematik 3			2,00	1,00	2,00		X	X				X			X	
3	Maschinenelemente 1			4,00	0,50	0,50	X	X		X						X	
3	Regelungstechnik			2,00	2,00	1,00	X	X					X		X		X
3	Technische Mechanik 3			4,00	0,50	0,50	X	X									
4	Fahrmechanik			2,00	2,00	1,00		X	X	X			X	X			X
4	Fahrzeugsensoren			2,00	2,00	1,00	X	X					X		X		X
4	Maschinenelemente 2			4,00	0,50	0,50	X	X		X	X	X	X				
4	Schwingungslehre			4,00	0,50	0,50	X	X									
4	Thermodynamik und Strömungsmechanik			1,00	4,00	0,00		X	X		X		X		X		
4	Wahlmodul 1			1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X
5	Automobilproduktion			1,00	1,00	3,00			X		X	X	X		X	X	
5	Fahrwerke			4,00	0,50	0,50	X	X	X	X	X		X		X	X	X
5	Fahrzeugantriebe			2,00	2,00	1,00	X	X	X		X	X		X	X		X
5	Fahrzeugkarosserie			3,50	0,50	1,00			X	X	X	X	X	X	X	X	X
5	Mechatronische Fahrzeugsysteme			2,00	1,50	1,50		X		X			X		X	X	X
5	Wahlmodul 2			1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X
6	Praxissemester			8,00	10,00	10,00	X	X	X	X	X	X	X	X		X	X
7	Bachelorarbeit			4,00	4,00	4,00	X	X	X	X	X	X	X	X		X	X
7	Interdisziplinäre Qualifikation			0,00	2,50	2,50		X					X		X		
7	Kolloquium			1,00	1,00	1,00	X	X	X	X	X	X	X	X		X	X
7	Studienarbeit			1,50	2,00	1,50		X	X	X	X	X	X			X	X
7	Wissenschaftliches Arbeiten 2			0,00	3,00	0,00		X			X	X	X		X		X

Modulmatrix Teil 2: Prüfungslast	Studiengang: Fahrzeugentwicklung / SR Fahrzeugtechnik						
Module / Lehrveranstaltungen				Art	Anzahl		Summe
Semester	Modul	Teilmodul/Lehrveranstaltung (optional)		PF, WPF, WF	Prüfungs-leistungen insgesamt	Mindest-anzahl WPF, WF	Prüfungen 42
1	Wissenschaftliches Arbeiten 1	M1.1		PF	0		0
2		M1.2		PF	1		1
1	Digitalisierung (BITs)	M2.1	BITs1	PF	1		1
3		M2.2	BITs2	PF	1		1
5		M2.3	BITs3	PF	1		1
1	Fertigungstechnik			PF	1		1
1	Informatik			PF	1		1
1	Ingenieurmathematik 1			PF	1		1
1	Physik			PF	1		1
1	Technische Mechanik 1			PF	1		1
1	Werkstoffkunde 1			PF	2		2
2	Betriebswirtschaftslehre			PF	1		1
2	Elektrotechnische Grundlagen			PF	1		1
2	Ingenieurmathematik 2			PF	1		1
2	Technische Mechanik 2			PF	1		1
2	Technisches Zeichnen			PF	1		1
2	Werkstoffkunde 2			PF	1		1
3	CAD			PF	1		1
3	Fahrzeugelektrik und -elektronik			PF	1		1
3	Ingenieurmathematik 3			PF	1		1
3	Maschinenelemente 1			PF	1		1
3	Regelungstechnik			PF	1		1
3	Technische Mechanik 3			PF	1		1
4	Fahrmechanik			PF	1		1
4	Fahrzeugsensoren			PF	1		1
4	Maschinenelemente 2			PF	1		1
4	Schwingungslehre			PF	1		1
4	Thermodynamik und Strömungsmechanik			PF	1		1
5	Automobilproduktion			PF	2		2
5	Fahrwerke			PF	1		1
5	Fahrzeugantriebe			PF	1		1
5	Fahrzeugkarosserie			PF	1		1
5	Mechatronische Fahrzeugsysteme			PF	1		1
6	Praxissemester			PF	1		1
7	Bachelorarbeit			PF	1		1
7	Interdisziplinäre Qualifikation			PF	1		1
7	Kolloquium			PF	1		1
7	Studienarbeit			PF	1		1
7	Wissenschaftliches Arbeiten 2			PF	1		1
4	Nutzfahrzeugtechnik			WPF	1		1
4	Grundlagen der Betriebsfestigkeit			WPF	1		
4	Einspritztechnik			WPF	1		
4	Oberflächen- und Schichttechnologie			WPF	1		
4	Pkw-Hydraulik			WPF	1		
4	Tribologie und Kraftfahrzeugbetriebsstoffe			WPF	1	1	
4	Verbrennungsmotoren			WPF	1		
4	Sachverständigenwesen I			WPF	1		
4	Sachverständigenwesen II			WPF	1		
4	Werkstoffprüfung			WPF	1		
4	Fahrzeugrestauration			WPF	1		
5	Nutzfahrzeugtechnik			WPF	1		1
5	Grundlagen der Betriebsfestigkeit			WPF	1		
5	Einspritztechnik			WPF	1		
5	Oberflächen- und Schichttechnologie			WPF	1		
5	Pkw-Hydraulik			WPF	1		
5	Tribologie und Kraftfahrzeugbetriebsstoffe			WPF	1	1	
5	Verbrennungsmotoren			WPF	1		
5	Sachverständigenwesen I			WPF	1		
5	Sachverständigenwesen II			WPF	1		
5	Werkstoffprüfung			WPF	1		
5	Fahrzeugrestaurierung			WPF	1		

Modulmatrix Teil 1: Profil **Studiengang: Fahrzeugentwicklung / SR Digitales Fahrzeug** **Fakultät 08**

Module / Lehrveranstaltungen				Handlungsfelder / Anzahl Kreditpunkte			Zuordnung Kompetenzen Absolvent*innenprofil							Zuordnung Studiengangkriterien			
Semester	Modul	Teilmodul/Lehrveranstaltung (optional)		72,00 ENT	70,00 ERP	67,00 HST	IGR	IAS	DIZ	CAE	VPD	HVA	PPL	Internationalisierung	Interdisziplinarität	Digitalisierung	Transfer
1	Wissenschaftliches Arbeiten 1	M1.1		0,00	1,00	0,00		X			X	X	X		X		X
2		M1.2		0,00	1,00	0,00		X			X	X	X		X		X
1	Digitalisierung (BITs)	M2.1	BITs1	1,00	0,00	0,00	X	X	X						X	X	
3		M2.2	BITs2	1,00	1,00	0,00	X	X	X						X	X	
5		M2.3	BITs3	1,00	1,00	0,00		X	X				X		X	X	
1	Fertigungstechnik			0,00	0,00	5,00			X		X	X		X	X	X	
1	Informatik			1,00	1,00	3,00		X	X	X				X	X	X	
1	Ingenieurmathematik 1			2,00	1,00	2,00	X	X								X	
1	Physik			2,00	2,00	1,00	X	X			X		X				
1	Technische Mechanik 1			4,00	0,50	0,50	X	X								X	
1	Werkstoffkunde 1			1,00	2,00	2,00	X				X	X	X	X	X		X
2	Betriebswirtschaftslehre			1,00	0,00	4,00						X	X	X	X		
2	Elektrotechnische Grundlagen			2,00	1,00	2,00	X	X								X	
2	Ingenieurmathematik 2			2,00	1,00	2,00	X	X								X	
2	Technische Mechanik 2			4,00	0,50	0,50	X	X									
2	Technisches Zeichnen			1,75	0,25	1,00	X	X	X	X						X	
2	Werkstoffkunde 2			1,00	2,00	2,00	X				X	X	X	X	X		X
3	CAD			1,75	0,25	1,00	X	X	X	X						X	
3	Fahrzeugelektrik und -elektronik			2,00	2,00	1,00	X	X		X					X	X	
3	Ingenieurmathematik 3			2,00	1,00	2,00		X	X				X			X	
3	Automatisiertes Fahren			2,00	1,00	2,00		X	X		X				X	X	
3	Regelungstechnik			2,00	2,00	1,00	X	X					X		X		X
3	Informatik 2			2,00	2,00	1,00		X	X	X					X	X	
4	Fahrmechanik			2,00	2,00	1,00		X	X	X			X	X			X
4	Fahrzeugsensoren			2,00	2,00	1,00	X	X					X		X		X
4	Autonomes Fahren			2,00	1,00	2,00		X	X		X				X	X	
4	Künstliche Intelligenz			1,00	3,00	1,00		X	X		X				X	X	
4	Thermodynamik und Strömungsmechanik			1,00	4,00	0,00		X	X		X		X		X		
4	Wahlmodul 1			1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X
5	Automobilproduktion			1,00	1,00	3,00			X		X	X	X		X	X	
5	Energiespeicher			2,00	2,00	1,00		X			X				X		
5	Vernetztes Fahren			2,00	1,00	2,00		X	X				X			X	
5	Elektromobilität			3,00	2,00	0,00		X	X						X	X	
5	Wasserstofftechnik			3,00	2,00	0,00						X	X		X		
5	Wahlmodul 2			1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X
6	Praxissemester			8,00	10,00	10,00	X	X	X	X	X	X	X	X		X	X
7	Bachelorarbeit			4,00	4,00	4,00	X	X	X	X	X	X	X	X		X	X
7	Interdisziplinäre Qualifikation			0,00	2,50	2,50		X					X		X		
7	Kolloquium			1,00	1,00	1,00	X	X	X	X	X	X	X	X		X	X
7	Studienarbeit			1,50	2,00	1,50		X	X	X	X	X	X			X	X
7	Wissenschaftliches Arbeiten 2			0,00	3,00	0,00		X			X	X	X		X		X

Modulmatrix Teil 2: Prüfungslast			Studiengang: Fahrzeugentwicklung / SR Digitales Fahrzeug				
Module / Lehrveranstaltungen				Art	Anzahl		Summe
Semester	Modul		Teilmodul/Lehrveranstaltung (optional)	PF, WPF, WF	Prüfungs-leistungen insgesamt	Mindest-anzahl WPF, WF	Prüfungen 42
1	Wissenschaftliches Arbeiten 1	M1.1		PF	0		0
2		M1.2		PF	1		1
1	Digitalisierung (BITs)	M2.1	BITs1	PF	1		1
3		M2.2	BITs2	PF	1		1
5		M2.3	BITs3	PF	1		1
1	Fertigungstechnik			PF	1		1
1	Informatik			PF	1		1
1	Ingenieurmathematik 1			PF	1		1
1	Physik			PF	1		1
1	Technische Mechanik 1			PF	1		1
1	Werkstoffkunde 1			PF	2		2
2	Betriebswirtschaftslehre			PF	1		1
2	Elektrotechnische Grundlagen			PF	1		1
2	Ingenieurmathematik 2			PF	1		1
2	Technische Mechanik 2			PF	1		1
2	Technisches Zeichnen			PF	1		1
2	Werkstoffkunde 2			PF	1		1
3	CAD			PF	1		1
3	Fahrzeugelektrik und -elektronik			PF	1		1
3	Ingenieurmathematik 3			PF	1		1
3	Automatisiertes Fahren			PF	1		1
3	Regelungstechnik			PF	1		1
3	Informatik in Fahrzeugsystemen			PF	1		1
4	Fahrmechanik			PF	1		1
4	Fahrzeugsensoren			PF	1		1
4	Autonomes Fahren			PF	1		1
4	Künstliche Intelligenz			PF	1		1
4	Thermodynamik und Strömungsmechanik			PF	1		1
5	Automobilproduktion			PF	2		2
5	Energiespeicher			PF	1		1
5	Vernetztes Fahren			PF	1		1
5	Elektromobilität			PF	1		1
5	Wasserstofftechnik			PF	1		1
6	Praxissemester			PF	1		1
7	Bachelorarbeit			PF	1		1
7	Interdisziplinäre Qualifikation			PF	1		1
7	Kolloquium			PF	1		1
7	Studienarbeit			PF	1		1
7	Wissenschaftliches Arbeiten 2			PF	1		1
4	Simulation von Kfz-Systemen			WPF	1		1
4	Berechnung von Faserverbundbauteilen			WPF	1		
4	Modernes Batteriemanagement			WPF	1		
4	Virtuelle Produktentwicklung			WPF	1		
4	Composite Design			WPF	1	1	
4	Einführung in Matlab			WPF	1		
4	Fahrwerksimulationstechnik			WPF	1		
4	Fahrzeugsicherheit			WPF	1		
4	Leichtbau			WPF	1		
5	Simulation von Kfz-Systemen			WPF	1		1
5	Berechnung von Faserverbundbauteilen			WPF	1		
5	Modernes Batteriemanagement			WPF	1		
5	Virtuelle Produktentwicklung			WPF	1		
5	Composite Design			WPF	1		
5	Einführung in Matlab			WPF	1	1	
5	Fahrwerksimulationstechnik			WPF	1		
5	Fahrzeugsicherheit			WPF	1		
5	Leichtbau			WPF	1		
5	eDrive			WPF	1		
5	eMotorsports			WPF	1		

Fields of activity: Fields of activity describe concrete activities that are carried out by the graduates in their later profession.	
ENT: Designing vehicles and vehicle systems The activity of designing includes the ability to make informative, conceptual and creative decisions when developing and designing new products.	The fields of activity in which the respective module imparts knowledge are marked by the CPs assigned in the field of activity. Divide the CP of your module among the three (or two, or one) fields of activity. The total amount of the CP must not exceed the CP of the module. Smallest divider: 0.5 CP
ERP: Testing vehicles and vehicle systems The activity of testing involves the ability to systematically plan and conduct experiments to answer specific questions that cannot, or can only with great difficulty, be answered analytically.	
HST: Producing vehicles and vehicle systems In order to solve engineering problems, the knowledge of the possible ways to manufacture the later product is an elementary component.	

Competences: The skills (competences) that a graduate should possess after graduation are described in the graduate profile. They are needed to be able to implement the activities related to the professional field. Often several competences are required in one or more fields of activity.	
IGR: Understanding of the fundamentals of engineering science Understanding the fundamentals of engineering science that are needed as a basis for further competences.	The competences taught can be marked by simply ticking the appropriate box. Several tick marks per module are allowed.
IAS: Analyzing and synthesizing as an engineer The ability to analyze engineering contexts, to solve problems and to draw on various information to find solutions.	
DIZ: Indentifying digital connections The identification of digital connections and the use of digital solution strategies.	
CAE: Applying CAE tools The application of computer-aided methods and simulations to solve development and production problems.	
VPD: Planning, performing and soundly evaluating tests The competence to carry out developmental and cause-seeking experiments and the corresponding systematic evaluation.	
ecological aspects Understanding of different manufacturing processes and the ability to name economic and ecological advantages and disadvantages; selection of manufacturing processes under technical, economic and ecological aspects.	
PPL: Planning and managing projects The competence to plan and manage in a team and to control projects.	

Imprint:

TH Köln
Gustav-Heinemann-Ufer 54
50968 Köln

www.th-koeln.de