Faculty of Automotive Systems and Engineering

Module Catalog
Automotive Engineering

Bachelor of Engineering (B. Eng.)

This is a translation of the original German document. For all legal purposes, only the German version of the module catalog shall be considered binding.

Technology
Arts Sciences
TH Köln

Content

Module Catalog | Automotive Engineering, Bachelor of Engineering

1 Program Description

The aim of the program is to impart basic engineering knowledge and subject-specific skills in the field of automotive engineering as well as the ability for general methodological and problem-oriented acting. For this purpose, the study plan starts with the fundamentals of Mathematics and Natural Science as well as with the fundamentals of engineering disciplines in order to ensure a uniform level of fundamental knowledge within the group of students. Besides the teaching of theoretical knowledge, especially in the first semesters of the program, there is a strong focus on project and practice-oriented teaching.

In the further course of the program, graduates will learn how to apply and further develop technical and scientific methods and knowledge in an independent and professional manner. Among other aspects, teaching includes tasks in development, design, calculation and testing of vehicles, vehicle systems and components using computer-assisted methods, as well as the practical performance of test benches and road tests.

The bachelor's degree program prepares students for an advanced engineering position in the automotive industry. Furthermore, the graduates acquire the ability to take on managerial tasks and to work in the management of a company in the medium term.

Possible employers are the automotive industry and the automotive supplier sector, service companies or the public sector. Furthermore, freelance work in an engineering office, e.g. as an expert or test engineer, is also possible. The program also lays the necessary foundations for a further scientific qualification in an additional Master's program.

2 Graduate Profile

The graduate profile stipulates that students will have the following competencies after graduation:

- understand engineering fundamentals,
- analyze and synthesize from an engineering point of view,
- recognize digital connections,
- apply CAE tools,
- plan, carry out and soundly evaluate experiments and simulations,
- select manufacturing processes under technical, economic and ecological aspects,
- plan and manage projects.

With these skills, graduates are able to serve the professional fields and to meet the needs of society.

3 Fields of Activity

The automotive engineering industry has high demands on future graduates and expect them to help them solve the future challenges. Especially the automotive industry is massively driven by social and political needs, which mainly concern the compliance with climate protection targets and the increasing digitalization.

Bearing this in mind, there are four future core topics for the Automotive Engineering degree program:

- vehicle systems / entire vehicle
- electric mobility
- digitalization / business models
- urbanization / mobility concepts.

Therefore, the aim of the program is to prepare students in these core areas for their future tasks in the companies. The overall professional fields of operation are:

- designing vehicles and vehicle systems,
- testing vehicles and vehicle systems,
- manufacturing vehicles and vehicle systems.

The design, testing and production is not limited to conventional vehicles and vehicle systems, but also include highly digitalized vehicles and components for electric drives.

4 Study Plan

	WS	SS	WS	SS	WS	SS	WS	SS	WS
Semester (WS = winter, SS= summer)	1	2	3	4	5	6	7	8	9

	Total	CP	CP	CP	CP	CP	CP	CP	CP	CP
Total Credits	**210**	**22**	**25**	**23**	**20**	**25**	**22**	**25**	**28**	**20**

Fundamentals of Mathematics and Natural Sciences	**42**	**17**	**15**	**10**						
StartIng (p = project)	2	2 (p)								
Mathematics for Engineers	15	5	5	5						
Fundamentals of Computer Science	5			5						
Physics	10	5	5							
Materials Science	10	5	5 (p)							

Fundamentals of Engineering	**60**	**5**	**10**	**13**	**12**	**20**				
Technical Mechanics I	5	5								
Technical Mechanics II	5		5							
Technical Mechanics III	5			5						
Vibration Theory	5				5					
Technical Drawing / CAD (p)	5			3 (p)	2					
Manufacturing Processes	5					5				
Machine Elements I	5		5							
Machine Elements II (p)	5			5 (p)						
Thermodynamics und Fluid Dynamics	5					5				
Electronics	5				5					
Control Engineering	5					5				
Vehicle Sensors (p)	5					5 (p)				

Automotive Engineering	**30**				**5**	**5**	**20**			
Driving Mechanics	5				5					
Vehicle Drivetrain	5						5			
Automotive Chassis	5						5			
Body Engineering	5						5			
Automotive Electrics and Electronics	5					5				
Automotive Systems Engineering	5						5			

Electives	**15**					**5**		**15**		
Electives	10							10		
Elective Projects	5							5 (p)		

Economy	**5**							**5**		
Business Administration	5							5		

Key Qualifications	**5**				**3**		**2**			
Blocks (e.g. languages …)	5				3		2			

Practical Engineering Semester	**28**								**28**	

Projects	**5**							**5**		**5**
Student Research Project	5							5 (p)		

Bachelor Seminar	5									5

Bachelor Thesis	**12**									**12**
Final oral examination	**3**									**3**

5 Alternative Study Plan

The degree program Automotive Engineering can also be studied in a more flexible format. The alternative study plan is intended to reduce the burden on students who, for example,

- pursue a regular occupation or work for an entire semester to finance their studies,
- are single parents and are not able to regularly attend the modules offered,
- care for close relatives and therefore need more time to finish their studies,
- are not able to finish their degree program in the standard period of study due to chronic diseases or disabilities and/or
- are competitive athletes who need to extend the duration of their studies due to their training.

The program content, scope of studies and examination elements are identical with those of the full-time study program. The only difference is a shift of the time regulations in the examination regulations, corresponding to the extended standard program duration.

How students organize their studies depends on their individual circumstances. It is possible to change between the options "semester by semester", study on certain weekdays, attend modules only in the morning, afternoon or evening, or do different "workloads" (credits) during the semesters.

The average study performance per semester is reduced to 78% of the workload compared to the seven-semester program, whereby the workload in the semesters fluctuates between 73 and 83% of the regular workload. An exception is the practical engineering internship with 28 credits. Since this internship is to be completed in the industry, a part-time arrangement cannot be offered by the university. Should an individual agreement on the reduction of weekly working hours between the student and the companies be made, the internship period is extended accordingly. It can also be agreed to divide the internship into several separated time periods.

All obligatory modules from the 4th semester onwards are offered in the summer and winter semester. The modules usually take place on two days a week. Recordings of the lectures and/or slides and prepared "transcripts" are mostly made available on the internet. Online forums in which students can ask and answer questions under the supervision of the responsible lecturer and the creation of chats in which opinions can be exchanged directly, support the "external" work on the teaching content.

Corresponding to the offered modules, students of the "flexible option" need to compile an individual timetable according to their needs. All compulsory modules must be attended in 9 semesters. Special attention must be paid to the fact that some modules build on each other and can therefore only be attended in a certain order.

The academic advisors will assist you in creating your individual study plan.

6 Module Matrix

Module Matrix	Degree Program: B. Eng. Automotive Engineering					Faculty 08 Automotive Systems and Production											
Modules / Courses				Areas of Activity / Number of CP			Competences from the graduate profile							Program Criteria				Examinations
Semester	Module	Lecturer	210 CP	81,5 ENT	62,3 ERP	66,3 HBT	IGR	IAS	DIZ	CAE	VPD	HVA	PPL	Internation-alization	Interdisci-plinarity	Digitaliza-tion	Transfer	Number 33
1	Starting	M. Frantzen	2		2,00			X			X	X	X		X		X	1
	Mathematics for Engineers I	M. Ruschitzka	5	2,00	1,00	2,00	X	X								X		1
	Physics I	J. Stollenwerk	5	2,00	2,00	1,00	X	X			X		X					1
	Materials Scienc I	P. Krug	5	1,00	2,00	2,00	X				X	X	X	X	X		X	1
	Technical Mechanics I	J. Blaurock	5	4,00	0,50	0,50	X	X								X		1
	Technical Drawing / CAD	C. Ruschitzka	3	1,75	0,25	1,00	X	X	X	X						X		1
	Manufacturing Processes	C. Hartl	5			5,00			X		X	X		X	X	X		1
2	Mathematics for Engineers II	M. Ruschitzka	5	2,00	1,00	2,00	X	X								X		1
	Physics II	J. Stollenwerk	5	2,00	2,00	1,00	X	X			X		X		X	X		1
	Materials Science II	P. Krug	5	1,00	2,00	2,00	X				X	X	X	X	X		X	1
	Technical Mechanics II	C. Kardelky	5	4,00	0,50	0,50	X	X										1
	Technical Drawing / CAD	C. Ruschitzka	2	1,75		0,25	X	X	X	X						X		1
	Machine Elements I	A. Faßbender	5	4,00	0,50	0,50	X	X		X						X		1
	Electronics	T. Viscido	5	2,00	1,00	2,00	X	X								X		1
3	Mathematics for Engineers III	M. Ruschitzka	5	2,00	1,00	2,00		X	X				X			X		1
	Fundamentals of Computer Science	R. Jendges	5	1,00	1,00	3,00		X	X	X				X	X	X		1
	Technical Mechanics III	C. Kardelky	5	4,00	0,50	0,50	X	X										1
	Machine Elements II	A. Faßbender	5	4,00	0,50	0,50	X	X		X	X	X	X					1
	Thermodynamics and Fluid Dynamics	K.-U. Münch	5	1,00	4,00			X	X		X		X		X			1
	Vehicle Electrics and Electronics	T. Viscido	5	2,00	2,00	1,00	X	X		X					X	X		1
4	Vibration Theory	C. Kardelky	5	4,00	0,50	0,50	X	X										1
	Control Engineering	T. Viscido	5	2,00	2,00	1,00	X	X					X		X		X	1
	Vehicle Sensors	T. Viscido	5	2,00	2,00	1,00	X	X					X		X		X	1
	Driving Mechanics	M. Frantzen	5	2,00	2,00	1,00		X	X	X			X	X			X	1
	Vehicle Drivetrain	R. Haas	5	2,00	2,00	1,00	X	X	X		X	X		X	X		X	1
	Elective Module 1	N. N.	5	1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X	1
5	Automotive Chassis	J. Betzler	5	4,00	0,50	0,50	X	X	X	X	X		X		X	X	X	1
	Body Engineering	F. Hermann	5	3,50	0,50	1,00			X	X	X	X	X	X	X	X	X	1
	Automotive Systems Engineering	T. Viscido	5	2,00	1,50	1,50		X		X			X		X	X	X	1
	Business Administration	C. D. Kim	5			5,00						X	X	X	X			1
	Elective Module 2	N. N.	5	1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X	1
	Elective Module 3	N. N.	5	1,00	2,00	2,00		X	X	X	X	X	X	X	X	X	X	1
6	Practical Engineering Semester	N. N.	28	8,00	10,00	10,00	X	X	X	X	X	X	X	X		X	X	0
7	Blocks of Key Qualifications	N. N.	5		2,50	2,50		X					X		X			0
	Student Research Project	N. N.	5	1,50	2,00	1,50		X	X	X	X	X	X			X	X	0
	Bachelor Seminar	N. N.	5	1,00	2,00	2,00		X			X		X		X			0
	Bachelor Thesis	N. N.	12	4,00	4,00	4,00	X	X	X	X	X	X	X	X		X	X	0
	Final Oral Examination	N. N.	3	1,00	1,00	1,00	X	X	X	X	X	X	X	X		X	X	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.	
HVA: Selecting manufacturing processes under technical, economic and 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.	

Module Matrix: Important Notes

The module matrix serves to locate all modules of a degree program in the context of its educational objectives. This initially includes the fields of activity that the degree program qualifies for. The fields of activity characterize the social needs that the program addresses.

It also comprises the graduate profile, which includes the competences that the students acquire during their studies. The acquisition of these competences should enable graduates to act in a scientifically guided and responsible manner within the framework of the career options defined by the fields of activity.

Abbreviations are used as placeholders in the table for the fields of activity and the competences to be acquired. In order to keep the table clear, it is recommended that abbreviations are also used to designate the fields of activity and competences assigned to a specific degree program. Depending on your needs, you can insert additional columns or delete redundant columns.

7 Modules

7.1 StartIng

Module Code:	1090
Module Title:	StartIng (project)
Type of Module:	obligatory module
ECTS Credits:	2
Language:	German (partly English content / literature)
Duration of Module:	usually 8 to 9 weeks at the beginning of the winter semester
Recommended for Semester:	1st semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. M. Frantzen
Lecturers:	Prof. Dr.-Ing. M. Frantzen, M. Schnitzler, M.Sc.
Learning Outcome:	The students - are able to plan a simple project, - can independently carry out a small project work, - calculate simple physical relationships, - know and identify the importance of key competences, - present and document work results in a professional form, - develop and use the essential rules of technical documentation.
Module Content:	- project-based teaching, - StartIng - Kick-Off: Introductory event, - competition, - project work in small groups and presentation of the results, - guidance and feedback discussions by pre-trained student tutors, - review: feedback discussions on the work processes in the groups and for the technical documentation by student tutors.
Teaching and Learning Methods:	project-based teaching and teamwork in small groups, kick-off introductory event, lectures, exercises, competition, feedback from tutors
Assessment Method:	events requiring attendance (certificates), teamwork, presentation of work results, competition, writing a technical report, final event
Workload (25 - 30 h ≙ 1 ECTS credit):	**60 h**
Contact hours:	Courses (2 hours per week per semester): **28 h**
Self-study:	Student´s pre and after workload: **22 h** Examination preparation: **10 h**
Recommended Prerequisites:	Good language skills (DE & EN), “Fachhochschulreife" (academic and practical part), fundamentals in Physics and Mathematics
Recommended Reading:	M. Frantzen; M. Schnitzler: Latest handouts for the StartIng module, M. Frantzen.: Latest Educational Product Development System-Pocket Card
Use of the Module in Other Degree Programs:	-
Particularities:	competition, feedback round

Last update:	29.10.2019

7.2 Mathematics for Engineers I

Module Code:	1010
Module Title:	Mathematics for Engineers I
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	1st semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr. rer. nat. M. Ruschitzka
Lecturers:	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, can reproduce, interpret and perform them - are able to illustrate, formulate and design the application relevance of the presented methods and procedures with examples especially from automotive engineering, - can describe, formulate and elaborate mathematical models with the help of basic mathematics, - know the basic options of computer software with numerical (Scilab or Matlab) or computer algebraic (Maple) methods to develop, analyze and calculate mathematical models.
Module Content:	Basic knowledge: Sets of numbers, equations and inequations, potencies, logarithms, elementary functions - vectors in three-dimensional space: vector algebra, coordinate representation, scalar product, vector product with determinants, scalar triple product, geometric applications, - linear systems of equations: Gaussian algorithm, Cramer's rule, geometric interpretation, - differential calculus of real functions with a 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:	• on-site teaching (lecture) • learning in small groups (calculation exercises) • independent practical work in small groups including presentation • technical discussion (individually)
Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	mathematics of 10th year at Gymnasium, initial reasons of vector calculus and analysis,

	if necessary attendance of a mathematics preliminary course or the online mathematics bridge course OMB+
Recommended Reading:	• L. Papula: Mathematik für Ingenieure, vol. 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 program Production and Logistics.
Particularities:	competition, feedback round
Last update:	11.11.2019

7.3 Mathematics for Engineers II

Module Code:	1020
Module Title:	Mathematics for Engineers II
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	2nd semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr. rer. nat. M. Ruschitzka, Prof. Dr.-Ing. R. Jendges
Lecturers:	Prof. Dr. rer. nat. M. Ruschitzka, Prof. Dr.-Ing. R. Jendges, 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, can reproduce, interpret and perform them - are able to illustrate, formulate and design the application relevance of the presented methods and procedures with examples especially from automotive engineering, - can describe, formulate and elaborate mathematical models with the help of basic mathematics, - know the basic options of computer software with numerical (Scilab or Matlab) or computer algebraic (Maple) methods to develop, analyze and calculate mathematical models.
Module Content:	• advanced differential calculus of real functions of a real variable: e.g. basic concepts of differential geometry • advanced 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 work in small groups including presentation • technical discussion (individually)
Assessment Method:	examination pre-condition: practical module examination (60 min)
Workload	**150 h**

(25 - 30 h ≙ 1 ECTS credit):	
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	mathematics of 10th year at Gymnasium, initial reasons of vector calculus and analysis, attendance of a mathematics preliminary course or the online mathematics bridge course OMB+ (if necessary)
Recommended Reading:	• L. Papula: Mathematik für Ingenieure, vol. 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 II in the bachelor's program Production and Logistics.
Particularities:	
Last update:	11.11.2019

7.4 Mathematics for Engineers III

Module Code:	1020
Module Title:	Mathematics for Engineers III
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	3rd semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr. rer. nat. M. Ruschitzka, Prof. Dr.-Ing. R. Jendges
Lecturers:	Prof. Dr. rer. nat. M. Ruschitzka, 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, can reproduce, interpret and perform them - are able to illustrate, formulate and design the application relevance of the presented methods and procedures with examples especially from automotive engineering, - can describe, formulate and elaborate mathematical models with the help of basic mathematics, - know the basic options of computer software with numerical (Scilab or Matlab) or computer algebraic (Maple) methods to develop, analyze and calculate mathematical models.
Module Content:	• introduction into 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 methods.
Teaching and Learning Methods:	• on-site teaching (lecture)

	• learning in small groups (calculation exercises) • independent practical work in small groups including presentation • technical discussion (individually)
Assessment Method:	examination pre-condition: practical module examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	basic knowledge from Engineering Mathematics I and Engineering Mathematics II.
Recommended Reading:	• L. Papula: Mathematik für Ingenieure, vol. 1 and vol. 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 III in the bachelor's program Production and Logistics as an elective module..
Particularities:	
Last update:	11.11.2019

7.5 Fundamentals of Computer Science

Module Code:	1040
Module Title:	Mathematics for Engineers III Fundamentals of Computer Science
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	3rd semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. R. Jendges
Lecturers:	Prof. Dr.-Ing. R. Jendges
Learning Outcome:	The students • can name the basic terms of software engineering and programming, • can recognize data types, data structures and control structures, • can execute the principles of modularized programming, • are able to use program libraries, • are able to develop their own programs, functions and macros, • can use the computer programming language C on a basic level.
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 (drafting exercises) • independent practical work in small groups
Assessment Method:	examination pre-condition: pass practical exercises examination (45 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	Courses (3 hours per week per semester): **48 h**
Self-study:	Student´s pre and after workload: **57 h** Examination preparation: **45 h**
Recommended Prerequisites:	
Recommended Reading:	Goll & Bröckl & Dausmann: C als erste Programmiersprache, Teubner, 2003
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	10.12.2019

7.6 Physics I

Module Code:	1050
Module Title:	Physics I
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	1st semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr. J. Stollenwerk
Lecturers:	Prof. Dr. Stollenwerk, Dr. A. Hilger
Learning Outcome:	The students • recognize the different types of error sources and are able to perform error calculation, • are able to provide a kinetic and dynamic description for simple mechanical systems, • can to draw conclusions from the energy and conservation of momentum about the behavior of mechanical systems, • can describe the basics of gravity, • can apply the method of linear regression and are able to generate graphical evaluations of measurement data in both linear and logarithmic application, • can generate a documentation of results with errors and know the meaning of the significant points.

Module Content:	Lecture: • basics of error calculation • classification of a movement: speed and acceleration • superposition principle for falling and throwing, circular movement, vehicle movement • concept of force, concept of Newtonian axioms: restoring force, centripetal force, inclined plane, frictional forces, pressure and buoyancy • determination of the center of gravity • solution strategies for mechanical problems using energy and pulse conservation • rotational movements: torque and mass moment of inertia, gravity: gravitational force, satellite navigation and geostationary satellites Practical training: • 4 experiments from the following subject areas: density determination, spring constant, mass moment of inertia, thermoelement, determination of the acceleration of gravity
Teaching and Learning Methods:	• on-site teaching (lecture with demonstrative experiments, seminar teaching with discussion of student solutions) • preparation of exercises in small groups as homework • independent practical work in small groups with protocol writing incl. error calculation, final discussion about the result.
Assessment Method:	examination (75 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	lecture: **42 h**; exercise: **14 h**; practical training: **12 h**
Self-study:	lecture: **8 h**; exercise: **28 h**; practical training: **16 h** examination preparation: **30 h**
Recommended Prerequisites:	
Recommended Reading:	Lecture script Tipler: Physik, Spektrum Akademischer Verlag, Heidelberg Meschede, Gerthsen: Physik, Springer Verlag, Berlin Lindner: Physik für Ingenieure, Vieweg Verlag, Braunschweig Further literature will be announced in the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	04.12.2019

7.7 Physics II

Module Code:	1060
Module Title:	Physics II
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	2nd semester

Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr. J. Stollenwerk
Lecturers:	Prof. Dr. Stollenwerk, Dr. A. Hilger
Learning Outcome:	The students • are capable of giving a kinetic and dynamic description for simple mechanical systems of the vibrations and waves, know the possible resonance phenomena and can draw mode pictures, • can calculate the sound velocity for gases, liquids and solids and recognize the difference between line and point sources, • can calculate the volume for technically relevant systems (roads, engines) in decibel measurement, • can describe the properties of light and the function of simple optical instruments, • are able to name the basic concepts of electromagnetism and can protect vehicle components from unwanted discharges, • can build simple electromagnets and electric motors themselves, • can calculate the error propagation according to the linear theory.
Module Content:	Lecture: • introduction to linear error propagation • **mechanical vibrations:** mass oscillator, thread pendulum, torsion pendulum, mathematical and physical pendulum, damping, resonance • **waves**: interference, standing wave, mode pictures, resonance • **acoustics:** sound propagation in gases, liquids and solids, line and point sources for sound, decibel measurement for measuring volume, Huygens law, Doppler effect, Macher cone • **optics:** history for the clarification of the nature of light, basic properties of light (reflection, refraction, total reflection, dispersion, color mixing, polarization, interference and diffraction, imaging properties of plane, hollow and arched mirrors and thin lenses, functioning of the eye and simple optical instruments (magnifying glass, telescope, microscope) • **electricity and magnetism**: electrical and magnetic forces, electrical charge, electric and magnetic field, potential term, field line images, electric dipole, condenser, capacity, lightning protection, electric current, Lorenz force, electromagnet, electric motor Practical training: • 3 experiments from the following subject areas: vibration theory, acoustics, optics and thermodynamics
Teaching and Learning Methods:	• on-site teaching (lecture with demonstrative experiments, seminar teaching with discussion of student solutions) • preparation of exercises in small groups as homework • independent practical work in small groups with protocol writing incl. error calculation, final discussion about the result.
Assessment Method:	examination (75 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	lecture: **42 h**; exercise: **14 h**; practical training: **12 h**
Self-study:	lecture: **8 h**; exercise: **28 h**; practical training: **16 h** examination preparation: **30 h**
Recommended Prerequisites:	
Recommended Reading:	Lecture script Tipler: Physik, Spektrum Akademischer Verlag, Heidelberg Meschede, Gerthsen: Physik, Springer Verlag, Berlin Lindner: Physik für Ingenieure, Vieweg Verlag, Braunschweig

	Further literature will be announced in the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	04.12.2019

7.8 Materials Science I

Module Code:	1070
Module Title:	Materials Science I
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	1st semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. P. Krug
Lecturers:	Prof. Dr.-Ing. P. Krug
Learning Outcome:	The students • know the basic concepts of materials science and the structure of materials, • know the relationship between macroscopic properties and their effects on the microscopic or atomic level and are able to describe relationships mathematically, • can explain the various methods of heat treatment of materials and select them appropriately for given objectives, • can select from a range of possible influences in order to change the properties of materials in a targeted manner, • can analyze rather complicated requirement profiles for components, • can apply methods of material selection, • know different methods of materials testing, • are able to describe, analyze and explain given test results with the theoretical contents of the course, • know the behavior of different materials or material groups, • know some of the manufacturing and material testing methods used in the processing of materials.
Module Content:	• fundamentals of atomic structure and materials science • bond types and crystal structure • mass transfer (diffusion) • elastic behavior • plasticity • phase diagrams • material groups • heat treatment • material testing procedures • manufacturing processes
Teaching and Learning Methods:	• on-site teaching

	• exercises • homework • final discussion (individually) • demonstrative experiments
Assessment Method:	examination (120 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**50 h**
Self-study:	**100 h**
Recommended Prerequisites:	Good knowledge in Chemistry, Physics, Mathematics and a good spatial awareness
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-Heineman
Use of the Module in Other Degree Programs:	
Particularities:	Passed mini-tests or successfully completed homework as admission requirement for the exam. The results of the mini-tests/thesis are added to the passed exam.
Last update:	09.12.2019

7.9 Materials Science II

Module Code:	1080
Module Title:	Materials Science II
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	2nd semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. P. Krug
Lecturers:	Prof. Dr.-Ing. P. Krug
Learning Outcome:	The students • know selected components of vehicle construction, their materials and manufacturing processes, • know realistic development processes, • know selection strategies for extensive parameter sets and target value conflicts, • know team-oriented project work,

	• are able to document project results in digital form, critically compare literature values and identify relevant results, • can plan and coordinate project-related tasks, • can identify, evaluate and assess different sources of information, • can communicate and present complex and extensive results in a targeted manner.
Module Content:	• material-oriented development processes in the automotive and supplier industry • project-related processes in development teams • component specific optimization strategies • cooperation of project teams working simultaneously • targeted documentation and presentation of test results
Teaching and Learning Methods:	• on-site teaching • oral presentation before and during the experiment • project-related practical training in groups • presentations • technical discussion (individually)
Assessment Method:	• oral presentation during the practical training, • documentation and evaluation of the project results, • keeping a laboratory book • presentation (lecture/poster)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**25 h**
Self-study:	**125 h**
Recommended Prerequisites:	Engineering Mathematics I, Technical Mechanics I, Physics I, good knowledge of Chemistry, good spatial awareness
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-Heineman
Use of the Module in Other Degree Programs:	
Particularities:	Passed exam in Materials Science I as admission requirement.
Last update:	09.12.2019

7.10 Technical Mechanics I

Module Code:	2410
Module Title:	Technical Mechanics I
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester

Recommended for Semester:	1st semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Jochen Blaurock
Lecturers:	Prof. Dr.-Ing. Jochen Blaurock
Learning Outcome:	The students • are able to name the properties of vectors and can disassemble and summarize vectors, • are able to apply the equilibrium conditions to modeled systems, • can calculate centers of gravity of bodies, • can assign supports, are able to model support reactions and calculate with the equilibrium conditions, • are able to analyze when they cannot calculate a system with the equilibrium conditions alone, • can calculate internal forces and bar forces, • are able to cut bodies free or can draw free body pictures, • can explain the difference between frictional and adhesive forces and calculate these.
Module Content:	• definition of mechanics and statics • definition of force and torque • properties of vectors • central force system • general force system • focus • support reactions • trusses • cut sizes • adhesion and friction
Teaching and Learning Methods:	• on-site teaching (lecture) • learning in small groups or individually (calculation exercises) • technical discussion (individually)
Assessment Method:	examination (90 min) (Admission requirement for the exam is that one of the two offered midterm tests have been passed.)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	• mathematical knowledge according to the advanced technical university entrance qualification ("Fachhochschulreife") • three-dimensional imagination
Recommended Reading:	• Gross, Hauger, Schnell: Technische Mechanik vol.1, Statik, Springer-Verlag. • Schnell, Gross: Formel und Aufgabensammlung zur Technischen Mechanik 1, Statik, B.I. Wissenschaftsverlag. • Holzmann, Meyer, Schumpich: Technische Mechanik - Statik, Teubner Verlag Stuttgart. • Wriggers et al.: Technische Mechanik kompakt, Teubner Verlag. • Hibbeler: Technische Mechanik 1 Statik, Pearson Verlag.
Use of the Module in Other Degree Programs:	B. Eng. Production and Logistics
Particularities:	

Last update:	02.10.2019

7.11 Technical Mechanics II

Module Code:	2420
Module Title:	Technical Mechanics II
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	2nd semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Ch. Kardelky
Lecturers:	Prof. Dr.-Ing. Ch. Kardelky
Learning Outcome:	The students • know the definition of mechanical stress and can transform given stresses in different directions, • know the notion of distortion and its relation to stresses, • can calculate the resulting stress from each internal force, • know how the stresses are distributed over the cross-section, • can integrate the differential equation(s) of the bending line, • are able to calculate deformations, • can analyze a system regarding its stability.
Module Content:	• definition and limits of Technical Mechanics II (TM II) (Elastostatics) • interaction with the module Technical Mechanics I (TM I) (Statics) • stress state, distortion state • law of elasticity • normal stress, shear stress, bending stress • deformations due to bending (and normal force) • lateral force, shear and shear deformation • torsion and deformation due to torsion • stability problems
Teaching and Learning Methods:	lecture and exercise
Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	mathematical knowledge according to the advanced technical university entrance qualification ("Fachhochschulreife"), knowledge of Technical Mechanics I
Recommended Reading:	Assmann, Selke: Technische Mechanik 2, Festigkeitslehre, Oldenbourg Verlag. Altenbach, Holzmann, Meyer, Schumpich: Technische Mechanik: Festigkeitslehre, Springer.

	Berger: Technische Mechanik für Ingenieure 2, Festigkeitslehre, Vieweg Verlag (Springer Vieweg). Brommundt, Sachs, Sachau: Technische Mechanik, De Gruyter Oldenbourg Verlag. Bruhns, Lehmann: Elemente der Mechanik II, Elastostatik, Vieweg Verlag (bzw. Springer Vieweg). Dankert, Dankert: Technische Mechanik, Springer Vieweg Verlag. 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:	
Particularities:	
Last update:	02.10.2019

7.12 Technical Mechanics III

Module Code:	2430
Module Title:	Technical Mechanics III
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	3rd semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Ch. Kardelky
Lecturers:	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 a momentary pole, • are able to determine degrees of freedom of simple systems, • can correlate force and displacement, mass and speed, or describe and apply torque and angle, mass moment of inertia and angular acceleration (impulse theorem, angular momentum theorem, energy theorem, working theorem) • can analyze combined translational-rotational problems
Module Content:	• definition of Technical Mechanics III (TM III) (Kinematics and Kinetics), • kinematics of a mass point (temporal relation between location, speed and acceleration): basic kinematic tasks, • motion in Cartesian, polar and natural coordinates • kinetics of the mass point (slant throwing, guided motion, impulse theorem, angular momentum theorem, energy theorem, work and work rate), • kinematics and kinetics of a rigid body, relative movement.

Teaching and Learning Methods:	lecture and exercise
Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	mathematical knowledge from the lecture Engineering Mathematics, knowledge from Technical Mechanics I and II
Recommended Reading:	*Assmann, Selke*: Technische Mechanik 2, Festigkeitslehre, Oldenbourg Verlag. Altenbach, Holzmann, Meyer, Schumpich: Technische Mechanik: Festigkeitslehre, Springer. *Berger*: Technische Mechanik für Ingenieure 2, Festigkeitslehre, Vieweg Verlag (Springer Vieweg). *Brommundt, Sachs, Sachau*: Technische Mechanik, De Gruyter Oldenbourg Verlag. *Bruhns, Lehmann*: Elemente der Mechanik II, Elastostatik, Vieweg Verlag (bzw. Springer Vieweg). *Dankert, Dankert*: Technische Mechanik, Springer Vieweg Verlag. *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:	
Particularities:	
Last update:	06.01.2020

7.13 Vibration Theory

Module Code:	2040
Module Title:	Vibration Theory
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th semester
Frequency:	twice a year: winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Ch. Kardelky
Lecturers:	Prof. Dr.-Ing. Ch. Kardelky
Learning Outcome:	The students • can define vibrations and analyze them in terms of basic concepts,

	• are able to solve homogeneous or inhomogeneous vibration differential equations and to adapt them to the initial and possibly boundary conditions, • are able to set up magnification functions, • can identify and apply the different cases of magnification functions, • can explain the difference between solutions in the time and frequency domain, • are able to calculate natural frequencies and natural vectors.
Module Content:	• relationship between the basic mechanical laws and the vibration theory, • basic concepts, free vibrations, initial and, where appropriate, boundary conditions, • dry friction, viscous damping, forced vibrations, • Lagrange's equations type 2, • vibrations with several degrees of freedom.
Teaching and Learning Methods:	lecture and exercise
Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**64 h**
Self-study:	**86 h**
Recommended Prerequisites:	Knowledge of differential equations and determinants, knowledge from TM II, TM III
Recommended Reading:	*Assmann, Selke: Technische Mechanik 3, Kinematik und Kinetik, Oldenbourg Verlag.* *Berger: Technische Mechanik für Ingenieure 3, Dynamik, Vieweg Verlag (Springer Vieweg).* *Brommundt, Sachs, Sachau: Technische Mechanik, De Gruyter Oldenbourg Verlag.* *Dankert, Dankert: Technische Mechanik, Springer Vieweg Verlag.* *Eller, Holzmann, Meyer, Schumpich: Technische Mechanik: Kinematik und Kinetik, Springer.* *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: Techn. Mechanik Band 3: Dynamik, Ed. Harri Deutsch, Europa Lehrmittel.* *Hibbeler: Technische Mechanik 3, Dynamik, Pearson Verlag.* *Jäger, Mastel, Knaebel: Technische Schwingungslehre, Springer Vieweg Verlag.* *Wriggers et al.: Technische Mechanik kompakt, Teubner Verlag (Springer Vieweg.*
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	06.01.2020

7.14 Technical Drawing / CAD

Module Code:	2070 2080
Module Title:	Technical Drawing / CAD
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	two semesters

Recommended for Semester:	1st / 2nd semester
Frequency:	once a year in the winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Ch. Ruschitzka
Lecturers:	CAD: Prof. Dr.-Ing. Ch. Ruschitzka, Technical Drawing: lecturer (tbd)
Learning Outcome:	The students • can name and apply presentation standards of technical drawing, • can calculate and select tolerances and fits based on general tolerances or the ISO system, • can apply the basic procedures of descriptive geometry, • can make technical drawings in the form of overall, group and single part drawings by hand and using CAD, • can compile a parts list, • are able to model parametric volume-based bodies using CAD, • can assemble these bodies into assemblies by applying conditions (constraints), • are able to derive 2D drawings from the bodies and assemblies, • can reflect the basics of parametric design, • can describe and apply the basic 3D methodologies.
Module Content:	Technical Drawing • Standards of presentation: standardized drawing and dimensioning, views, sectional drawings, thread drawings, surface details, drawing types, title blocks, parts lists, workpiece and model images. • Tolerances and fits: dimensional, form and positional tolerances, fits (general tolerances, ISO system, fit selection) • Basics of descriptive geometry: central and parallel projections, orthogonal two- and three-panel projection, section of the level with the body, penetrations and unwindings of bodies Basics of 3D solid modelling and drawing derivation with CAD • creation of sketch-based 3D volume models • structure of assemblies • 2D-drawing derivation.
Teaching and Learning Methods:	• on-site teaching (lecture/exercise) • learning in small groups (calculation exercises for the ISO fitting system) • independent working on tasks for technical drawing and descriptive geometry in small groups • presence exercises and practical training on the CAD system with special relevance for automotive engineering • use of modularly structured, small tasks, which enable the students step by step to practically apply 3D methods • individual expert discussions for methodology transfer
Assessment Method:	Technical Drawing: independent preparation of technical drawings including selection of fits CAD: construction and drawing derivation of individual parts as well as the construction of a small assembly on the trained CAD system
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**

Contact hours:		1. Semester lecture/exercise/training	2. Semester lecture/exercise/training
	Courses (2+2 SWS):	**32 h**	**32 h**
Self-study:		1. Semester lecture/exercise/training	2. Semester lecture/exercise/training
	Student´s pre and after work:	**16 h**	**16 h**

	Drafting of drawings:	**32 h**	**22 h**
Recommended Prerequisites:			
Recommended Reading:	*Hoischen: TECHNISCHES ZEICHNEN, Cornelsen Girardet.* *Susanna Labisch, Christian Weber: TECHNISCHES ZEICHNEN, Vieweg Verlag.* *Further current literature will be announced during the lecture.*		
Use of the Module in Other Degree Programs:			
Particularities:			
Last update:	15.01.2020		

7.15 Manufacturing Processes

Module Code:	2330		
Module Title:	Manufacturing Processes		
Type of Module:	obligatory module		
ECTS Credits:	5		
Language:	German		
Duration of Module:	one semesters		
Recommended for Semester:	1st semester		
Frequency:	once a year in the winter semester		
Person Responsible for this Module:	Prof. Dr.-Ing. Christoph Hartl		
Lecturers:	Prof. Dr.-Ing. Christoph Hartl		
Learning Outcome:	The students • can correlate the basics of the manufacturing processes, • are able to make a suitable process selection for a given manufacturing task, taking into account the respective technical process possibilities and the objectives to be achieved in terms of product costs, production times and product quality.		
Module Content:	Application-relevant fundamentals of industrially used manufacturing processes for the production and processing of components made of metallic materials, plastics, ceramics and glass: original forming processes, forming processes, separating processes, coating processes, generative manufacturing.		
Teaching and Learning Methods:	on-site teaching (lecture), learning in small groups (calculation exercises)		
Assessment Method:	examination (120 minutes)		
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**		
Contact hours:		lecture	exercise
	Courses (3 SWS):	**48 h**	**32 h** **16 h**
Self-study:		lecture	exercise
	Student´s pre and after work:	**48 h**	**32 h** **16 h**
	Drafting of drawings:	**54 h**	
Recommended Prerequisites:	Basic knowledge from the modules Materials Science, Technical Mechanics,		

	Physics and Mathematics.
Recommended Reading:	*Fritz, A. H. u. a.*: Fertigungstechnik, Berlin u. a., Springer Verlag, 2015. *Westkämper, E./Warnecke, H.-J.*: Einführung in die Fertigungstechnik, Stuttgart u. a., Teubner Verlag, 2010. Further literature will be announced on a material-related basis in the lectures.
Use of the Module in Other Degree Programs:	B. Eng. Production and Logistics
Particularities:	
Last update:	16.12.2019

7.16 Machine Elements I

Module Code:	2050
Module Title:	Machine Elements I
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semesters
Recommended for Semester:	2nd semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr. Axel Faßbender
Lecturers:	Prof. Dr. Axel Faßbender
Learning Outcome:	The students are able to use technical terms in the context of the discussed machine elements and to describe mechanisms of action in order to perform and evaluate simple design tasks, such as pre-dimensioning, strength verification or structural design, using the fundamental calculation methods.
Module Content:	standardization, tolerances, tribology, strength according to FKM guideline, bearing arrangements, axles and shafts, seals, shaft-hub connections, springs
Teaching and Learning Methods:	Teaching method: a mixture of on-site teaching, digi-Vote, blended learning Learning method: interactive e-book with exercises, small-step self-study exercises in the learning management system.
Assessment Method:	examination (120 minutes) (prerequisite for the admission to the exam is that one of two offered subtests is passed.)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**60 h**
Self-study:	**90 h**
Recommended Prerequisites:	Technical Drawing, Materials Science I, Manufacturing Processes, Technical Mechanics I, Physics I
Recommended Reading:	*Faßbender, A., Blaurock, J.: Interaktiver Grundkurs Maschinenelemente Band I, Hanser Verlag, München, ab 10/2020.*

	Faßbender, A., Blaurock, J.: Interaktive Aufgaben zu Maschinenelementen Band I, Hanser Verlag, München, ab 2020. *Decker, Maschinenelemente – Tabellen und Diagramme, Hanser Verlag, München, aktuelle Auflage.*
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.12.2019

7.17 Machine Elements II

Module Code:	2060
Module Title:	Machine Elements II
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semesters
Recommended for Semester:	3rd semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr. Axel Faßbender
Lecturers:	Prof. Dr. Axel Faßbender
Learning Outcome:	Project stage I - individual The students are able to use technical terms in the context of the machine elements dealt with and to describe mechanisms of action, in order to perform and evaluate simple design tasks, such as pre-dimensioning, strength verification or structural design, using the basic calculation methods. Project stage II - team/individual The students are able to use technical terms in the context of the gear means and to describe mechanisms of action in order to be able to design, calculate and construct a constant ratio gear unit using the basic calculation methods.
Module Content:	Project stage I - individual screwed joints, pin and bolt joints, substance-to-substance joints (bonding, soldering, welding) Project stage II - team/individual gear units (gear wheels, belts, chains), gearbox
Teaching and Learning Methods:	Project stage I - individual Teaching method: impulse lectures | parameterized, low complex individual tasks Learning method: interactive e-book with exercises, project-based learning Project stage II - team/individual Teaching method: impulse lectures | projected team task, calculation software MDesign, CAD, practical assembly and disassembly exercises for vehicle transmissions of electric vehicles Learning method: project and team-based learning

Assessment Method:	Project stage I - individual homework Project stage II - team/individual Team: detailed structural concept, technical report, presentation Individual: test for gear units (30 min.) (Admission requirement for project stage II is, that project stage I has been passed.)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**20 h**
Self-study:	**40 h** (independently at the TH in a supervised setting) **90 h**
Recommended Prerequisites:	Technical Drawing / CAD, Machine Elements I, Materials Science I, Materials Science II, Technical Mechanics I, Technical Mechanics II
Recommended Reading:	*Faßbender, A., Blaurock, J.: Interaktiver Grundkurs Maschinenelemente Band II, Hanser Verlag, München, ab 10/2021.* *Faßbender, A., Blaurock, J.: Interaktive Aufgaben zu Maschinenelementen Band II, Hanser Verlag, München, ab 2021.* *Decker, Maschinenelemente – Tabellen und Diagramme, Hanser Verlag, München, aktuelle Auflage.* Further literature will be recommended or made available for specific projects.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.12.2019

7.18 Thermodynamics and Fluid Dynamics

Module Code:	2130
Module Title:	Thermodynamics and Fluid Dynamics
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semesters
Recommended for Semester:	3rd semester
Frequency:	once a year in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. K.-U. Münch
Lecturers:	Prof. Dr.-Ing. K.-U. Münch
Learning Outcome:	The students • can explain the basic concepts of thermo- and fluid mechanics, • are able to describe the basic calculation methods and them to specific tasks at, • can describe thermodynamic and fluidic systems of the vehicle, • are able to carry out 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 (state variable temperature, conservation of energy, quantitative determination 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 the conservation of mass, energy (Bernoulian equations) and the impulses • fundamentals of frictional flow (boundary layer theory) • flow separation • fundamentals of motor vehicle aerodynamics
Teaching and Learning Methods:	on-site teaching (lecture and exercise) with practical training experiment
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (6 hours per week per semester: **80 h** practical training - wind channel: **4 h**
Self-study:	Student´s pre and after class preparation: **30 h** examination preparation: **36 h**
Recommended Prerequisites:	Knowledge from Mathematics I, II and Physics I, II
Recommended Reading:	*Gersten, K.: Strömungsmechanik, Shaker Verlag, Aachen, 1997.* *Baehr, H.D.: Thermodynamik, Springer Verlag, Berlin, Heidelberg.*
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	10.12.2019

7.19 Electronics

Module Code:	2310
Module Title:	Electronics
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semesters
Recommended for Semester:	2nd semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Prof. Dr.-Ing. Toni Viscido
Learning Outcome:	The students • can describe the electro technical fundamentals relevant to vehicle electrics and electronics,

	• the properties of selected electrical components in the vehicle as well as electronic components, • can examine and calculate electrical circuits of direct and alternating current technology as well as simpler semiconductor circuits, • can design OP amplifier circuits and analog filters.
Module Content:	• Fundamentals of Electrical Engineering (energy, voltage, electric current, electric field, passive/active, linear/non-linear two poles, conductivity, temperature influence, electrical hazards) • energy storage and management (energy storage overview, starter battery) • direct current circuits (branched direct current circuits, Kirchhoff, substitute two-pole source, mesh current method, throttle potentiometer, Wheatstone bridge for air mass measurement) • alternating current circuits (complex alternating current calculation, pointer diagram, complex power calculation) • operational amplifier circuits, • analog filters.
Teaching and Learning Methods:	• media-supported physical on-site teaching with digital provision of study-accompanying learning material via intranet-based learning platform (lecture) - pre-calculation exercise and moderation in the application of solution methods on typical practice-oriented tasks (exercise) - learning target tests for admission to the exams (“LZK-Lernzielkontrollen”)
Assessment Method:	written examination (90 min) A successful completion of the LZK is the admission requirement to the examination.
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	lecture exercise courses (3 hours per week per semester): **48 h** **32 h** **8 h**
Self-study:	lecture exercise Student´s pre and after class preparation: **48 h** **32 h** **16 h** examination preparation (LZK incl.): **54 h**
Recommended Prerequisites:	Physics I, Mathematics I
Recommended Reading:	*Elektrotechnik (Pearson Studium - Elektrotechnik), Manfred Albach.* *An additional detailed literature review will be announced during the event.*
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.01.2020

7.20 Control Engineering

Module Code:	2320
Module Title:	Control Engineering
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semesters

Recommended for Semester:	4th semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Dr.-Ing. Dirk Bernhardt
Learning Outcome:	The students • can explain the fundamentals of control engineering using examples of single-mesh control loops, • can model real technical structures in transfer functions, • can apply the control loop analysis in the time and frequency domain, • are able to outline control engineering issues in circuit diagrams in a structured way, • can design controllers according to empirical setting rules, • are able to examine the stability of control loops, • can handle basic actuators and sensors with active principles.
Module Content:	• fundamentals of the control loop (elements, structural analysis, applications) • stationary and dynamic behavior • description of transmission blocks in the time and frequency domain • command and disturbance behavior of control loops • draft of a regulation in the time domain
Teaching and Learning Methods:	• media-supported physical on-site teaching with digital provision of study-accompanying learning material via intranet-based learning platform (lecture) • moderation in the application of solution methods to typical, practice-oriented tasks (exercise) • illustration of the learning material through computer-supported demonstrations and animations (Matlab/Simulink)
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	lecture exercise courses (3 hours per week per semester): **48 h** **32 h** **16 h**
Self-study:	lecture exercise Student´s pre and after class preparation: **48 h** **32 h** **16 h** examination preparation (LZK incl.): **54 h**
Recommended Prerequisites:	Physics I, Mathematics I, Electronics, Vehicle Electronics, Mathematics for Engineers I, II and III
Recommended Reading:	*Heimann, B.: Mechatronik, Hanser Verlag, 2007.* *Czichos, H.: Mechatronik, Vieweg Verlag, 2008.* *An additional detailed literature review will be announced during the event.*
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.01.2020

7.21 Vehicle Sensors

Module Code:	2340

Module Title:	Vehicle Sensors
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semesters
Recommended for Semester:	4th semester
Frequency:	once a year in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Dr.-Ing. Xin Wu
Learning Outcome:	The students • can explain the functionality of sensors and actuators and specify requirements from the vehicle system perspective, • can explain basic actuators and sensors with operating principles, structure, control of actuators and processing of sensor signals and describe the technical aspects of the designs of actuators and sensors, • can explain essential properties of actuators and sensors, • can select sensors according to requirements, • can conceptualize measurement chains, including a cost analysis.
Module Content:	Overview of sensors, sensor types and relevant actuators: • basic characteristics, general parameters, • structure (microscopic / macroscopic), • operating principles (mechanical, optical, electrical, acoustic, etc.) • properties for measuring of displacement, angle, rotational speed, velocity, yaw rate, acceleration, flow, force, torques, pressure, current, temperature, gas, concentration, etc, • sensor integration, • vehicle sensor versions • electrical actuators and technical vehicle integration.
Teaching and Learning Methods:	• media-supported physical on-site teaching with digital provision of study-accompanying learning material via intranet-based learning platform (lecture) • moderation in the application of solution methods to typical, practice-oriented tasks (exercise)
Assessment Method:	examination (90 min), semester paper as admission requirement to the examination
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): lecture **48 h**, exercise **32 h** **16 h**
Self-study:	student´s pre and after class preparation: **24 h** lecture 16 h exercise **8 h** semester paper **36 h** examination preparation (LZK incl.): **42 h**
Recommended Prerequisites:	Physics I and II, Electronics, Vehicle Electronics, Mathematics for Engineers I, II and III
Recommended Reading:	
Use of the Module in Other Degree Programs:	
Particularities:	

Last update:	17.01.2020

7.22 Driving Mechanics

Module Code:	3010
Module Title:	Driving Mechanics
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German (partly with English content/literature)
Duration of Module:	one semesters
Recommended for Semester:	4th semester
Frequency:	twice a year: in the summer and winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. M. Frantzen
Lecturers:	Prof. Dr.-Ing. M. Frantzen
Learning Outcome:	The students • understand the generation of forces on the wheel, • distinguish between dynamic and static wheel radius, • know and analyze driving mechanical fundamentals and facts, • calculate axle and wheel loads, the power or performance required, • develop typical driving mechanical characteristics diagrams, • analyze the fuel consumption of vehicles, • develop braking force distribution diagrams and compare braking strategies, • compare geometric and physical effects when driving curves, • examine and calculate lateral dynamic relationships.
Module Content:	• fundamentals, center of gravity position, mass moments of vehicles, • wheel and tire, forces, frictional connection, wheel slip, different wheel radii, • static and dynamic axle load distribution, driving resistances, power requirements, • vehicle identification, characteristic maps of drives and identification converters, • driving performance, consumption, driving condition and fuel consumption diagram, • driving limits, front, rear and all-wheel drive, braking, brake force distribution, • cornering (stationary curve behavior), lateral dynamics (single-track model)
Teaching and Learning Methods:	lecture, exercise, computer-based practical training with Excel and IPG CarMaker
Assessment Method:	Solving practical training tasks with compulsory confirmation of course attendance (an optional alternative date for repeaters) as a preliminary work for admission to the written exam, written exam (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (5 hours per week per semester): **70 h** (lecture: **42 h**, exercise: **14 h**, practical training: **14 h**)
Self-study:	student´s pre and after class preparation: **50 h** (lecture **16 h**, exercise **20 h**, practical training **14 h**) examination preparation: **30 h**
Recommended Prerequisites:	Mathematics for Engineers, Physics (Mechanics, Kinetics, Kinematics)

Recommended Reading:	Breuer, S.; Rohrbach-Kerl, A.: Fahrzeugdynamik, Vieweg, 2015
Use of the Module in Other Degree Programs:	
Particularities:	practical training in the CAx laboratory, laboratory approval necessary (instruction in the first week)
Last update:	09.12.2019

7.23 Vehicle Drivetrain

Module Code:	3052
Module Title:	Vehicle Drivetrain
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German + English-friendly (learning material in English)
Duration of Module:	one semesters
Recommended for Semester:	4th semester
Frequency:	twice a year: in the summer and winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Rainer Haas
Lecturers:	Prof. Dr.-Ing. Rainer Haas
Learning Outcome:	After the successful completion of the module, the students are able to differentiate between different drive train designs and to classify them, in addition, they know the structure and the functioning of the associated components. The students have learned to apply the fundamentals of kinematics, kinetics and thermodynamics in the area of the drive train, so that components and their operating process can be calculated and designed. Furthermore, the students can estimate, assess and compare the consumption of different drive configurations based on the component efficiency appropriately. They are familiar with the necessary test scopes and the associated procedures.
Module Content:	structure and function of various powertrain concepts, as well as the associated component arrangement analysis of the powertrain to derive development specifications framework conditions of the automotive industry and related strategies for development and production functioning and characteristics of the different power transmission paths from the primary drive to the wheel structure and comparison of different combustion and electrical primary drives metrological measurement of engine power, internal work and heat flows of the combustion engine for the calculation of general characteristics and efficiency as an example dynamic forms of excitation of the combustion engine and associated countermeasures structure and operation of couplings and hydraulic converters structure and function of identification converters and their machine elements in different models demonstration of gears in simple mechanical models as a tool in the design and development calculation principles of longitudinal and lateral waves, as well as embodiments and their dynamic transmission behavior comparison of the energetic overall evaluation of different types of primary drives

	determination of consumption and the procedure for its simulation measuring the efficiency of components fundamentals of testing based on risk assessment and Failure Mode and Effects Analysis (FMEA) during the development process scope of testing derived from the durability requirements, functioning and reliability structure, components and operating procedures of all-wheel drive vehicles with mechanical and hybrid-electric engine
Teaching and Learning Methods:	on-site teaching application-oriented calculation exercises practical training in groups
Assessment Method:	Practical training + examination (120 min) The practical training is a graded part of the examination. A successful participation in the practical training is a prerequisite for the registration for the exam.
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**50 h** (lecture/exercise: 42 h, practical training: 8 h)
Self-study:	**100 h** (lecture/exercise: 42 h, practical training: 18 h, examination preparation: 40 h)
Recommended Prerequisites:	Basic knowledge of Physics, Electrical Engineering, Machine Elements and Materials Science Sound knowledge of Kinematics and Kinetics and Thermodynamics
Recommended Reading:	Cornel Stan: Alternative Antriebe für Automobile / Alternative Propulsion for Automobiles List: Das Getriebebuch / The Automotive Transmission Book Lechner, Naunheimer: Fahrzeuggetriebe / Automotive Transmissions Seherr-Thoss, Schmelz, Aucktor: Gelenke und Gelenkwellen / Universal Joints and Driveshafts van Basshuysen, Schäfer: Handbuch Verbrennungsmotoren / Internal Combustion Engine Handbook Hofmann: Hybridfahrzeuge / Denton: Electric and Hybrid Vehicles Reif: Konventioneller Antriebsstrang und Hybridantriebe Schlücker, Will, Spicher, Eifler: Küttner Kolbenmaschinen Robert Bosch GmbH: Kraftfahrtechnisches Taschenbuch / Automotive Handbook Kirchner: Leistungsübertragung in Fahrzeuggetrieben Heinz Grohe Gerald Russ: Otto- und Dieselmotoren Braess, Seiffert: Vieweg Handbuch Kraftfahrzeugtechnik / Robert Bosch GmbH: Fundamentals of Automotive and Engine Technology Johannes Looman: Zahnradgetriebe
Use of the Module in Other Degree Programs:	
Particularities:	study material (power point slides etc.) available in English
Last update:	09.12.2019

7.24 Automotive Chassis

Module Code:	3020
Module Title:	Chassis Systems
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German (English summary and script)

Duration of Module:	one semester
Recommended for Semester:	5th semester
Frequency:	twice a year: in the winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. J. W. Betzler
Lecturers:	Prof. Dr.-Ing. J. W. Betzler
Learning Outcome:	The students can describe the basic driver-oriented requirements for chassis, methods for describing vehicle behavior including the relevant chassis systems and components and their functions are able to apply the fundamentals learned to practical problems, can derive solutions from the analyzed problems, are able to evaluate the solution variants achieved with particular attention to driver requirements.
Module Content:	Requirements for the chassis, methods for describing vehicle behavior, power transmission properties of tires, braking behavior of vehicles, structure and characteristics of wheel suspensions.
Teaching and Learning Methods:	on-site teaching (lecture) seminar teaching and learning in small groups (application and case studies up to the development and evaluation of solutions) independent practical work in small groups (6 students) summary of the lectures in the English language script in the German and English language
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**80 h**
Self-study:	**70 h**
Recommended Prerequisites:	Driving Mechanics
Recommended Reading:	Breuer, B.; Bill, K.-H.: Bremsenhandbuch, Wiesbaden, Vieweg-Verlag, 4. Aufl. 2012. Robert Bosch GmbH: Kraftfahrzeugtechnisches Taschenbuch, Wiesbaden, Vieweg-Verlag, 26. Aufl. 2007. Hacken, Karl-Ludwig: Grundlagen der Kraftfahrzeugtechnik. 5. Aufl. München, Carl Hanser Verlag, 2018. Heißing, Bernd, Ersoy, Metin, Gies, Stefan (Hrsg.): Fahrwerkhandbuch, Heidelberg, Springer-Verlag, 4. Aufl, 2013. Reimpell, J.; Betzler, J.W.: Fahrwerktechnik: Grundl. 5. Aufl. 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. Aufl. 1988. Stoll, H.: Lenkanlagen und Hilfslenkungen, Würzburg, Vogel Buchverlag, 1992.
Use of the Module in Other Degree Programs:	M.Sc. Automotive Engineering
Particularities:	
Last update:	09.12.2019

7.25 Body Engineering

Module Code:	3030
Module Title:	Body Engineering
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	5th semester
Frequency:	twice a year: in the winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. F. Herrmann
Lecturers:	Prof. Dr.-Ing. F. Herrmann
Learning Outcome:	The students have the basic knowledge about the classification of the body development in the overall development process, can describe all common body construction methods in detail and are able to create their own body concepts, can explain the structure and function of the most important assemblies of the vehicle body, are able to create their own detailed designs of the assemblies of a car body, can apply bodywork-specific material knowledge, are able to describe bodywork relevant forming and joining processes, are able to evaluate the feasibility of their own body designs from both technical and economic aspects.
Module Content:	introduction (concept vehicles, marketing and vehicle definition) design and construction of current body concepts (conventional large series body, large series body with alternative package concept, luxury class limousine in aluminum, small car in aluminum, sports car in aluminum) depiction of construction material selection mechanic properties assembly concepts (bumper system, doors and flaps, instrument panel cross members) structural concept "passive safety" / occupant restraint system car body materials (steels, semi-finished aluminum products, plastics) car body specific forming and joining processes
Teaching and Learning Methods:	on-site teaching (lecture) classroom discussions during the creation of student concepts and drafts revision in form of an exercise (students create their own body concepts and assembly designs under supervision)
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	Courses (5 hours per week per semester): **80 h** (lecture/exercise)
Self-study:	student´s pre and after class preparation: **40 h** examination preparation: **30 h**
Recommended Prerequisites:	Basic knowledge from the modules Materials Science, Mechanics (Statics, Elastostatics,

	Kinematics and Kinetics, Vibration Theory) and Manufacturing Technology / Logistics. Please note the examination regulations §24(8).
Recommended Reading:	A constantly updated, detailed bibliography will be announced at the beginning of the lecture
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.26 Automotive Electrics and Electronics

Module Code:	3070
Module Title:	Automotive Electrics and Electronics
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	3rd semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Prof. Dr.-Ing. Toni Viscido
Learning Outcome:	The students can apply the Maxwell equations (flow, induction, source freedom), are able to describe the mode of operation of all DC machines in detail and assign them while meeting the demands, can describe the mode of operation of alternating current machines in detail and assign them while meeting the demands (permanent magnet synchronous motor (PMSM), asynchronous motor), can describe the mode of operation of the three-phase generator in the vehicle´s electrical system in detail and assign it as required, can describe and calculate power electronics for the control of alternating current machines for the use in electrically powered vehicles in detail, can apply decimal, hexadecimal and binary number systems in detail, can convert time and value-continuous signals into time and value-discrete signals, can describe and design digital circuits for signal processing, can calculate digital filters, can describe digital bus systems in automobiles and calculate signals.
Module Content:	magnetic field: properties and parameters, forces, electromagnetic induction electric machines: direct current machines, alternating current machines power electronics: function, structure, control, design of power electronic circuits for the control of the 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-calculation exercise and moderation in the application of solution methods on typical practice-oriented tasks (exercise) independent processing of tasks and performance of tests in a team with other students (practical training)
Assessment Method:	written examination (90 min) successful attendance of the practical training as examination prerequisite
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (6 hours per week per semester): **56 h** (lecture: **32 h**, exercise: **16 h**, practical training: **8 h**)
Self-study:	student´s pre and after class preparation: **40 h** **40 h** (exercise: **16 h**, practical training: **8 h, 16 h**) examination preparation: **54 h**
Recommended Prerequisites:	Electrical Engineering, Mathematics for Engineers I to II (complex calculation), Information Technology
Recommended Reading:	Elektrotechnik (Pearson Studium - Elektrotechnik) von Manfred Albach (author) A detailed bibliography review will be announced during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	17.01.2020

7.27 Automotive Systems Engineering

Module Code:	3060
Module Title:	Automotive Systems Engineering
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	6th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Prof. Dr.-Ing. Toni Viscido, Dipl.-Ing. Dietrich Burkardt
Learning Outcome:	The students can describe the mode of operation, the structure and the components of the most important vehicle systems, can explain the mechatronic development cycle and use it in practical problems,

	are able to carry out the steps of modeling, analysis and synthesis in the development of vehicle systems.
Module Content:	introduction to the vehicle systems of longitudinal, lateral and vertical dynamics, actuators, sensors, bus systems and control units, electrical on-board power supply 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 (calculation exercise under supervision) independent practical training in teams of 3 students (technical simulation tasks on current topics) blended learning
Assessment Method:	examination (90 min), practical training as examination prerequisite
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): lecture: **48 h**, 32 h, 16 h practical training: 4**8 h**
Self-study:	student´s pre and after class preparation: **40 h** lecture: **24 h 16 h 8 h** examination preparation: **30 h**
Recommended Prerequisites:	Fundamentals of Control Engineering, Electrical Engineering, Hydraulics Fundamentals of the software Matlab Simulink
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:	
Particularities:	
Last update:	17.01.2020

7.28 Aerodynamics

Module Code:	5122
Module Title:	Aerodynamics
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester

Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. K.-U. Münch
Lecturers:	Prof. Dr.-Ing. K.-U. Münch
Learning Outcome:	The students can describe the basic relationships of the flow around blunt bodies (vehicle), can describe the relationship between vehicle resistance, downforce, and mechanisms of air conditioning and pollution, are able to adapt the above-mentioned relationships to different types of vehicles
Module Content:	introduction/overview/motivation fundamentals of fluid mechanics (“repetitorium”), key figures of vehicle aerodynamics, wind tunnel technology, wind tunnel measurement technology, phenomena of flow separation partial resistances and detail optimization, lift on vehicles, dirt, 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:	examination (60 %) report on practical training (20 %) presentation (20 %)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): 4**8 h**
Self-study:	student´s pre and after class preparation: **45 h** examination preparation: **30 h** seminar **27 h**
Recommended Prerequisites:	Fundamentals of Thermodynamics and Fluid Dynamics
Recommended Reading:	Hucho, W.H.: Aerodynamik des Automobils, Vieweg, 2005.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.29 Fundamentals of Structural Durability

Module Code:	5250
Module Title:	Fundamentals of Structural Durability
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester

Recommended for Semester:	5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. P. Krug
Lecturers:	Prof. Dr.-Ing. P. Krug
Learning Outcome:	The students can name the basic concepts of operational stability, know the materials science processes at different component loads and the relevant test methods for characterizing the relevant material´s behavior, can describe the experimental methods for determining fatigue properties, can apply computational methods to determine fatigue strength, can determine the fatigue life on the basis of experimental results, can test different materials and evaluate the test results, are able to select adequate methods to extend the service life in a targeted manner, taking into account the material and the load spectrum, can read, understand and evaluate relevant English technical texts.
Module Content:	fundamentals of fatigue strength deformation behavior of different material groups under static, cyclic and dynamic load fatigue behavior of metallic materials experimental principles of fatigue strength proof of operational stability fundamentals of wear fundamentals of corrosion fundamentals of creep load fundamentals of special charges
Teaching and Learning Methods:	on-site teaching (lecture) practical training project guest lecturers technical discussion (individually) exercises in English presentations in English
Assessment Method:	final oral examination
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**50 h**
Self-study:	**100 h**
Recommended Prerequisites:	Mathematics for Engineers I; Technical Mechanics I; Physics 1; good knowledge of Chemistry, good spatial awareness
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:	
Particularities:	passed examination in Materials Science I
Last update:	09.12.2019

7.30 CAD II

Module Code:	5230
Module Title:	CAD II
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. Ch. Ruschitzka
Lecturers:	Prof. Dr.-Ing. Ch. Ruschitzka
Learning Outcome:	The students can explain the fundamentals and terms of CA technologies, can describe important starting points for the automation of design and development processes with the help of virtual product development, can explain the conceptual design of CAD systems and their data structures are able to design components with the help of surfaces and analyze them and can use the most important CAD systems for the automotive industry in a practice-oriented manner.
Module Content:	fundamentals and terms of CAD technologies automation of the design and development process conceptual design of CAD systems DMS, PDM, PLM systems parametric modeling and direct modeling data and model structures in CAx systems construction and analysis of (freeform) surfaces virtual development processes in automotive engineering feature technologies macro programming
Teaching and Learning Methods:	on-site teaching (lecture) alternative to lectures: seminar-based teaching with integrated learning success controls presence exercises and practical training in small groups on the CAD systems with a large relevance for automotive engineering use of modularly structured, small tasks, that teach students the skills step by step technical discussions (individually) in some instances, independent processing of a small project with subsequent presentation
Assessment Method:	examination (120 min) alternative 1 (if chosen by the participants): - examination (60 min) with a rating of 50 % and a graded small project including a presentation (rating of 50%) alternative 2 (if chosen by the participants): - seminar courses with several tests

	The successful attendance of the practical training is a prerequisite for the examination.
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	Courses (5 hours per week per semester): **80 h** (lecture: **32 h,** practical training: **48 h**)
Self-study:	student´s pre and after class preparation: **40 h** (lecture: **16 h,** practical training: **24 h**) examination preparation: **30 h**
Recommended Prerequisites:	fundamental knowledge from the modules Technical Drawing / CAD and Machine Elements
Recommended Reading:	Since the system-related literature, e.g. on CATIA and NX, changes with each release, the literature list will be updated and announced in the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	14.08.2019

7.31 Composite Design

Module Code:	5296
Module Title:	Composite Design
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Dipl.-Ing. J. Gehrmann
Lecturers:	Dipl.-Ing. J. Gehrmann
Learning Outcome:	The students are able to describe the advantages and disadvantages of this material group and to use them for technical applications, can name the usual FRP composite materials and describe their processing methods, can use FRP components in the construction according to the material, are able to design a laminate with calculation tools.
Module Content:	fundamentals of FRP composite materials overview of the usual processing methods basic rules of construction applied calculation of laminates examples from application areas
Teaching and Learning Methods:	on-site teaching (lecture) course discussions exercises with practical examples case studies in small groups

Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	Courses (3 hours per week per semester): **48 h** (lecture: **48 h,** practical training: **16 h**)
Self-study:	student´s pre and after class preparation: **62 h** examination preparation: **40 h**
Recommended Prerequisites:	fundamental knowledge from the areas Materials Science, Mechanics (Statics, Elasto-statics, Kinematics, Vibration Theory) and Lightweight Body Design/ FEM
Recommended Reading:	H. Schürmann: Konstruieren mit Faser-Kunststoff-Verbunden, VDI-Buch Series, Springer Verlag 2005, ISBN 3540402837. AVK e.V. (Hrsg.): Handbuch Faserverbundkunststoffe, 3. Auflage, Vieweg + Teubner Wiesbaden 2010, ISBN 978-3-8348-0881-3.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.32 Introduction to MATLAB

Module Code:	5308
Module Title:	Introduction to MATLAB
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Dr.-Ing. Emad Farshizadeh
Lecturers:	Dr.-Ing. Emad Farshizadeh
Learning Outcome:	The students are familiar with the basics of the MATLAB development environments commonly used in the industry, - are able to create entire 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 of m-files and m-functions logical and relational 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 individual programming work
Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	Courses (3 hours per week per semester): lecture: **48 h** (lecture: **24 h**, practical training/exercise **24 h**)
Self-study:	student´s pre and after class preparation: **62 h** examination preparation: **40 h**
Recommended Prerequisites:	Basic knowledge of Mathematics for Engineers and Computer Sciences.
Recommended Reading:	The current literature will be provided during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	06.01.2020

7.33 eDrive – Electric Drives in Vehicles

Module Code:	5116
Module Title:	eDrive – Electric Drives in Vehicles
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. U.-M. Gundlach
Lecturers:	Prof. Dr.-Ing. U.-M. Gundlach
Learning Outcome:	The students can explain electric drive concepts in electric and hybrid vehicles and are able to calculate the energy and mileage requirements of the vehicles, can explain the electronic components and basic functions of power electronics circuits and their influence on the operating behavior of electrical machines, can explain the mode of operation and the operating behavior of different electrical machines, can describe and compare the basic properties and parameters of electrochemical storage devices in vehicles, are able to evaluate and select electric drives in vehicles according to specified criteria.
Module Content:	perspectives of alternative mobility: economic, ecological, social aspects, availability of raw materials, energy balance, design variants of the electrified powertrain

	engineering basics of drives: analysis of motion sequences, driving resistances, power and energy, model-based concept of drives, heating/cooling, acceleration/braking, operating modes power electronics: electronic components, circuit variants, control methods, pulse width modulation (PWM) electrical machines: fundamentals of DC machine, synchronous and asynchronous motors, design and operating behavior, losses and warming, law of growth electrochemical energy storage: battery types, charge/discharge, battery management
Teaching and Learning Methods:	media-assisted on-site teaching (lecture) providing study material via the digital platform ILIAS learning in small groups with subsequent presentation tutoring during the application of solution methods for typical practice-oriented exercises (exercise)
Assessment Method:	examination (120 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	Courses (3 hours per week per semester): lecture: **48 h** **48 h**)
Self-study:	student´s pre and after class preparation: **62 h** 62 h examination preparation: **40 h**
Recommended Prerequisites:	Physics, Mathematics for Engineers, Electrical Engineering, Vehicle Electrics and Electronics
Recommended Reading:	Detailed literature review will be provided during the course.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.34 Fuel Injection Technology

Module Code:	5150
Module Title:	Fuel Injection Technology
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. K.-U. Münch
Lecturers:	Prof. Dr.-Ing. K.-U. Münch
Learning Outcome:	The students

	are able to understand the essential terms and relationships of motor injection technology, are able to describe the main tasks of fluid atomization in petrol and diesel engines, can explain the relationship between pollutant emissions and fuel consumption, can classify the need to develop new drive systems in relation to the state of the art.
Module Content:	introduction, overview, motivation, system design 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 design of storage injection systems, influence of injection systems on mixture formation and emission, measuring methods/test equipment, simulation of high-pressure systems, injection systems of gasoline engine, intake manifold injection, direct injection gasoline engine, development trends of Otto engine injection, future developments: new fuels, new drives.
Teaching and Learning Methods:	on-site teaching (lecture) practical exercises on component test stands
Assessment Method:	examination (60 %) seminar (20 %) practical training (20 %)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (4 hours per week per semester): **64 h**
Self-study:	student´s pre and after class preparation: **64 h** examination preparation: **22 h**
Recommended Prerequisites:	Basic knowledge in the field of Thermodynamics and Fluid Mechanics.
Recommended Reading:	Bosch: "Dieselmotormanagement", Vieweg, Braunschweig, 2002.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.35 Simulation of Chassis Motion

Module Code:	5270
Module Title:	Simulation of Chassis Motion
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	twice a year: in the winter and summer semester (not taking place at the moment)
Person Responsible for this Module:	Prof. Dr.-Ing. J. W. Betzler

Lecturers:	Prof. Dr.-Ing. J. W. Betzler
Learning Outcome:	The students can describe basic options for the simulation of axle kinematics and vehicle movement, are able to perform basic simulations with the software Adams/Car, can analyze simulated results with regard to their relevance to vehicle dynamics, derive improvement potential of the solutions developed.
Module Content:	methods for the simulation of vehicle movement behavior, effects of parameter variations of the chassis geometry
Teaching and Learning Methods:	seminar teaching perform case studies individual practical work
Assessment Method:	technical examination (50 %) project work (50 %)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**64 h**
Self-study:	**86 h**
Recommended Prerequisites:	Basic knowledge especially of Chassis Technology and from the areas Mechanics (Statics, Elastostatics, Kinematics, Vibration Theory) and Driving Mechanics.
Recommended Reading:	Heißing, Bernd, Ersoy, Metin, Gies, Stefan (Hrsg.): Fahrwerkhandbuch, Heidelberg, Springer-Verlag, 4. Aufl, 2013. Reimpell, J.; Betzler, J.: Fahrwerktechnik: Grundlagen, Vogel Buchverlag, Würzburg, 2005, 5. Auflage. Reimpell, J.; Stoll, H.; Betzler, J. W.: The Automotive Chassis, Oxford, Verlag Butterworth Heinemann, 2001. Reimpell, J.: Radaufhängungen, Vogel Buchverlag, Würzburg, 1992. Further literature will be provided during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.12.2019

7.36 Vehicle Diagnostics

Module Code:	5309
Module Title:	Vehicle Diagnostics
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	twice a year: in the winter and summer semester (not taking place at the moment)

Person Responsible for this Module:	Dr.-Ing. Oliver Brockmann
Lecturers:	Dr.-Ing. Oliver Brockmann
Learning Outcome:	The students should learn the aspects and methods of current vehicle diagnostic systems, and be able to independently read and critically interpret diagnostic data from a vehicle after having completed the lecture. In a holistic approach, this includes not only knowledge of and handling on- and off-board diagnostic systems, but also basic knowledge of how data networks and sensors work in vehicles.
Module Content:	state of the art vehicle diagnostics different systems for on and offboard diagnosis 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 vehicles design and function of sensors in vehicles practical application of vehicle diagnostics
Teaching and Learning Methods:	on-site teaching practical training
Assessment Method:	practical training written examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): **48 h** (lecture: **16 h**, exercise: **16 h**, practical training: **16 h**)
Self-study:	student´s pre and after class preparation: **60 h** examination preparation: **42 h**
Recommended Prerequisites:	basic knowledge of Electrical Engineering, Vehicle Electrics and Electronics
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, vol.2, Springer Verlag.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.37 Vehicle Vibrations and Acoustics (NVH)

Module Code:	5290
Module Title:	Vehicle Vibrations and Acoustics
Type of Module:	optional module
ECTS Credits:	5
Language:	German

Duration of Module:	one semester
Recommended for Semester:	5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Rainer Haas
Lecturers:	Prof. Dr.-Ing. Rainer Haas
Learning Outcome:	After the successful completion of the module, students are able to explain the importance of acoustics in modern vehicle development and to describe the most important parameters and methods. The students will have learned the most important terms of acoustics and signal analysis and are able to deal with questions that might arise in practical situations. Furthermore, the students will be familiar with the measurement and analysis software commonly used in the automotive industry, as well as the corresponding measuring equipment and transducers.
Module Content:	development perspectives in automotive engineering and acoustic optimization in the vehicle development process introduction to mechanical vibration, acoustics and signal analysis phenomena, concepts and components in vehicle acoustics basic machine acoustic equation and its application in automotive engineering excitation mechanisms, transmission paths and radiation behavior introduction to computer-aided methods of vehicle acoustics measurement and calculation metrological recording of structure-borne and airborne sound using practical examples
Teaching and Learning Methods:	on-site teaching practical training in groups
Assessment Method:	practical training + oral examination The practical training is graded and part of the examination.
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**50 h** (lecture/exercise: **42 h**, practical training: **8 h**)
Self-study:	**100 h** (lecture/exercise: **28 h**, practical training: **32 h**, examination: **40 h**)
Recommended Prerequisites:	basic knowledge of Physics and Mathematics and advanced knowledge in Kinematics, Kinetics and Vibrations
Recommended Reading:	Zeller: Handbuch Fahrzeugakustik Agilent Technologies: Fundamentals of Modal Testing Kollmann: Maschinenakustik Ewins: Modal Testing – Theory, Practice and Application Bruel & Kjaer: Primers - Measuring Vibration, Measuring Sound, Sound Intensity, Structural testing Schmidt: Schalltechnisches Taschenbuch Genuit: Sound-Engineering im Automobilbereich Gasch: Knote Liebig: Strukturdynamik Möser: Technische Akustik / Engineering Acoustics
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	15.11.2019

7.38 Vehicle Safety

Module Code:	5160
Module Title:	Vehicle Safety
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	A. Sprenger
Lecturers:	A. Sprenger
Learning Outcome:	The students can specify the requirements of legislation for the safety of vehicles, can describe the basic rules and requirements of vehicle registration and approval
Module Content:	development of the vehicle inventory legal requirements for vehicle safety requirements according to the §13 EG-FGV examinations ECE- individual approvals
Teaching and Learning Methods:	on-site teaching (lecture) learning in small groups (calculation exercises)
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester**):** lecture: **48 h**, exercise: **36 h, 12h**)
Self-study:	student´s pre and after class preparation: **66 h** examination preparation: **36 h**
Recommended Prerequisites:	
Recommended Reading:	lecture script Further literature will be provided during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	06.01.2020

7.39 Light Framing / FEM

Module Code:	5118
Module Title:	Light Framing / FEM

Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	twice a year: in the winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. F. Herrmann
Lecturers:	Prof. Dr.-Ing. F. Herrmann
Learning Outcome:	The students can explain and apply the mechanical, elastokinematics basics, which is needed for the basic understanding of the FE method, can use a commercial FEM program for basic, mechanical lightweight construction questions, are able to completely analyze the mechanical stress state in the investigated assembly on the basis of the results and carry out an optimization of the design, are able to perform simple nonlinear FEM analysis.
Module Content:	explanation of the basic principle of FEM based on the matrix stiffness method (theory and derivation of a truss example) overview of properties of commercial FEM programs introduction to the operation of the commercial FEM program ABAQUS model generation (elements, material, boundary conditions, solution methods) for linear and non-linear stress analyses independent development of FEM solutions for lightweight construction problems in the area of the body structure
Teaching and Learning Methods:	lecture mainly computer-based exercise
Assessment Method:	oral examination with a possible use of computers (30-60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester**):** lecture: **48 h**
Self-study:	student´s pre and after class preparation: **62 h** examination preparation: **40 h**
Recommended Prerequisites:	
Recommended Reading:	
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.40 Commercial Vehicles

Module Code:	5110

Module Title:	Commercial Vehicles
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	H. Gees
Lecturers:	H. Gees
Learning Outcome:	The students can explain the legal requirements for the design of a commercial vehicle with regard to masses and lengths, can classify commercial vehicle types and assign the requirements for a type class are able to determine vehicle dynamics parameters of a commercial vehicle or can estimate the effect of conceptual changes on this variable, can describe the properties of components that are specific for commercial vehicle, are able to define interfaces between chassis and body.
Module Content:	legal basis history type studies driving mechanics of the commercial vehicle component studies (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:	graded project work
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester**):** lecture: **48 h**
Self-study:	student´s pre and after class preparation: **22 h** project work: **80 h**
Recommended Prerequisites:	basic knowledge from the modules Statics, Elastostatics, Kinematics and Kinetics, Machine elements and Driving Mechanics
Recommended Reading:	*Hoepke, E.; Breuer, S.*: Nutzfahrzeugtechnik, 4. Auflage, 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:	
Particularities:	
Last update:	03.12.2019

7.41 Surface and Coating Technology

Module Code:	5280
Module Title:	Surface and Coating Technology
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr. J. Stolllenwerk
Lecturers:	Prof. Dr. J. Stolllenwerk
Learning Outcome:	The students can explain the most important terms of vacuum technology (pressure ranges, vapor pressure concept of mean free path length), can distinguish between the different types of discharge in plasma physics and can explain the principle of cathode sputtering, can classify the variety of deposition techniques available on the market for CVD and PVD and are able to select a suitable process for a given application, can explain the mode of operation of the main coating methods like magnetron sputtering, thermal evaporation, electron beam evaporation, arc process, can describe technically relevant layer systems (wear and corrosion protection, transparent conductors, metallization, thermal insulation glazing).
Module Content:	Lecture: fundamentals of vacuum and plasma technology fields of application of surface and layer technologies in automotive engineering: engine (injection valves, pistons and cylinder running surfaces) transmission (low friction coatings for tribological applications) slide bearings corrosion and wear protection glass coatings (rear, front and side windows, dashboard, rear-view mirror) headlamp metallization plastic bumpers Practical training: generation of a high vacuum by a turbo molecular pumping station recording of the current-voltage characteristics of a magnetron discharge deposition of titanium and titanium nitride using the magnetron sputtering technique
Teaching and Learning Methods:	on-site teaching (lecture and exercise) vacuum and plasma technology demonstrations practical training with preparation of a protocol in small groups presentation of the results of the practical training
Assessment Method:	presentation of a group work including a written elaboration or exam (75 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	lecture: **34 h**, exercise: **14 h,** practical training: **8 h**
Self-study:	lecture: **22 h**, exercise: **8 h**, practical training: **24 h**; examination preparation: **40 h**

Recommended Prerequisites:	completion of Physics I and Physics II with the grade “good” or “very good”
Recommended Reading:	*Frey, H*.: Vakuumbeschichtung Bd.1 - 5, VDI-Verlag, Düsseldorf. Further literature will be provided during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	23.01.2020

7.42 Passive Safety

Module Code:	5299
Module Title:	Passive Safety
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester (not taking place this year)
Person Responsible for this Module:	n.a.
Lecturers:	n.a.
Learning Outcome:	The students know the basics of passive safety, have basic knowledge of biomechanics and accident mechanics, know the real road traffic accident occurrence and which institutions collect accident data e.g. GIDAS, have become acquainted with the legal requirements and the demands of consumer protection regarding passive safety, know vehicle systems to minimize the risk of injury in the event of an accident e.g. restraint systems, learn how crash-relevant body structures are designed, know test scenarios for the simulation of a road traffic accident, are familiar with the experimental implementation of full vehicle and component tests (e.g. crash tests), the metrological recording of physical quantities during the test (e.g. dummies) and the calculation of injury criteria from the measured values, know how a road traffic accident is considered in the vehicle development process.
Module Content:	introduction to vehicle safety: active and passive safety basics of (trauma) biomechanics: structure and load limits of the human body accident research, accident statistics and accident scenarios legal requirements for passive safety: the type-approval procedure for passenger cars consumer protection requirements: New Car Assessment Programme (NCAP) technical measures for passenger cars to increase passive safety: body structures and restraint systems excursion (subject to availability)
Teaching and Learning Methods:	lecture, project work

Assessment Method:	project work with presentation and technical discussion
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): **48 h**
Self-study:	student´s project work: **80 h** preparation for examination: **22 h**
Recommended Prerequisites:	completion of Physics I and Physics II with the grade “good” or “very good”
Recommended Reading:	Will be provided during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.43 Vehicle Hydraulics

Module Code:	5282
Module Title:	Vehicle Hydraulics
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr. Axel Faßbender
Lecturers:	Prof. Dr. Axel Faßbender
Learning Outcome:	The students are able to describe the fundamental hydraulic interrelationships and apply them to the mechanisms of action of hydraulic car components to understand and pre-dimension the function of basic hydraulic circuits in order to be able to estimate the energy demand.
Module Content:	symbols, physical/hydraulic fundamentals, print media, hydraulic components in passenger cars: pumps, valves, hydraulic motors, hydraulic accumulators, hydraulic applications in cars: steering, brakes, vibration damping, active chassis systems, transmission, engine
Teaching and Learning Methods:	on-site teaching with lectures and exercises in small groups
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**45 h**
Self-study:	**105 h**

Recommended Prerequisites:	Machine Elements I and II, Physics I and II
Recommended Reading:	Murrenhoff, H.; Schmitz, K.: Grundlagen der Fluidtechnik: Teil 1: Hydraulik, Shaker Verlag GmbH, Aachen, aktuelle Auflage. Grollius, H.-W.: Grundlagen der Hydraulik, Hanser Verlag, München, aktuelle Auflage.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.12.2019

7.44 Quality Management

Module Code:	5400
Module Title:	Quality Management
Type of Module:	optional module
ECTS Credits:	5
Language:	English (“german-friendly course”)
Duration of Module:	one semester
Recommended for Semester:	5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Rainer Pusch
Lecturers:	Prof. Dr.-Ing. Rainer Pusch
Learning Outcome:	The students can implement standard requirements for a quality management system in a familiar field of work by identifying requirements on the basis of the defined terms and principles of quality management, formulating objectives and describing processes, in order to be able to later participate in the development of QM systems, identify, eliminate and avoid the causes of defects by choosing the appropriate methods for data acquisition, data analysis and cause identification and apply them to later solve quality problems reactively and preventively.
Module Content:	definitions and fundamental terms of quality management requirements of quality management standards application of the so-called PDCA (Plan-Do-Check-Act) cycle on the levels of o companies in general o business processes (e.g. product development, procurement) o products methods to support the PDCA cycle advanced quality planning
Teaching and Learning Methods:	on-site teaching: seminar-based teaching (lecture, exercises, seminar with individual presentation), learning in small groups, company excursion, guest speakers.
Assessment Method:	examination (90 minutes). In the exercise, bonus points can be earned to improve the exam grade.
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**

Contact hours:	**56 h**
Self-study:	**94 h**
Recommended Prerequisites:	basic knowledge from the modules Mathematics, Statistics, Business Organization, Design I and Manufacturing Materials.
Recommended Reading:	Linß: Qualitätsmanagement für Ingenieure, Carl Hanser Verlag, 2011. DIN Taschenbuch 226: Qualitätsmanagement – QM-Systeme und –Verfahren, Beuth Verlag, 10. Auflage, 2019. Theden/Colsman; Qualitätstechniken – Werkzeuge zur Problemlösung und ständigen Verbesserung, 5. Auflage, Carl Hanser Verlag, 2013. VDA/AIAG: FMEA-Handbuch, 1. Ausgabe 2019.
Use of the Module in Other Degree Programs:	B.Sc. Logistics (7th semester)
Particularities:	
Last update:	09.12.2019

7.45 Accident and Damage Assessment I

Module Code:	5210
Module Title:	Accident and Damage Assessment I
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	A. Sprenger
Lecturers:	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 state sector German traffic law StVO German Road Traffic Licensing Regulations (StVZO) FZV (Vehicle Registration Regulations)
Teaching and Learning Methods:	on-site teaching (lecture) learning in small groups (calculation exercises)
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): lecture: **48 h**, exercise: 36 h, 12 h

Self-study:	student´s project work: lecture:**60 h, 48 h 12 h** preparation for examination: **42 h**
Recommended Prerequisites:	
Recommended Reading:	lecture script Further literature will be provided during the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	The module is rated with 6 SWS in the first half of the semester.
Last update:	06.01.2020

7.46 Accident and Damage Assessment II

Module Code:	5220
Module Title:	Accident Damage Assessment II
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	A. Sprenger
Lecturers:	A. Sprenger
Learning Outcome:	The students can write 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 or individually (calculation exercises)
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester**):** lecture: **48 h,** exercise: **36 h……12 h**
Self-study:	student´s pre and after class preparation: **60 h 36 h ….24 h** project work: **42 h**
Recommended Prerequisites:	
Recommended Reading:	lecture script Further literature will be provided in the lecture.

Use of the Module in Other Degree Programs:	
Particularities:	The module counts with 6 SWS in the second half of the semester.
Last update:	06.01.2020

7.47 Simulation of Vehicle Systems

Module Code:	5297
Module Title:	Simulation of Vehicle Systems
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. R. Jendges
Lecturers:	Prof. Dr.-Ing. R. Jendges
Learning Outcome:	The students know the essential characteristics of commercial software tools for the simulation of vehicle systems, are able to use appropriate simulation systems and interpret the simulation results, are able to classify and evaluate to solution methods for linear and non-linear problems, can implement elementary solution methods for linear and non-linear differential equation systems by programming, can name all motor components and describe their tasks.
Module Content:	vehicle-related simulation programs (for MKS (Matlab, Adams, DSHPlus etc.) and continuous systems (Comsol, Abacus etc.) simulation problems and solution methods: c classification, solution methods, iterative methods and relaxation methods, autonomous systems, vibration problems methods of model building of real and computer models, physical systems and others, analytical/numerical models, discrete/continuous systems programming simulation and verification
Teaching and Learning Methods:	practical training / feedback discussions / presentation / documentation (50%) oral examination (50 %)
Assessment Method:	examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (4 hours per week per semester**):60 h (**lecture: **30 h,** practical training: **30 h)**
Self-study:	self-studies including examination preparation: **90 h**
Recommended Prerequisites:	Mathematics for Engineers I to III
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:	
Particularities:	
Last update:	10.12.2019

7.48 Tribology and Operating Fluids

Module Code:	5260
Module Title:	Tribology and Operating Fluids
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	M. Winkler
Lecturers:	M. Winkler
Learning Outcome:	The students can name and explain the basic concepts of tribology, can explain the structure and properties of lubricants, fuels and coolants used in motor vehicles, can name the relevant classifications and specifications of the operating fluids, are able to estimate the toxicological effects of the operating fluids.
Module Content:	Fundamentals of Tribology: friction and wear mechanisms Viscosity and density: Newtonian and non-Newtonian fluids, kinematic and dynamic viscosity, dependence of viscosity on temperature, pressure and shear rate, density behavior under the influence of pressure and temperature Oil: origin, deposits, production, extraction, refining Base oils for lubricants: types, production, properties, additives for lubricants Fuels: types and properties, test methods for lubricants: mechanical, dynamical, and and analytical Engine oils and gear oils: national and international classifications and specifications, company specifications and approvals, base oil selection and additives Roller bearing lubrication: calculation and estimation of the service life taking into account the lubricating oils and greases used Grease: development, production, properties and applications of lubricating greases

	Other lubricants: hydraulic oils for special aggregates, cooling machines for air conditioning, other special products Coolant: specifications and composition of coolants, manufacturer specifications Fuels: petrol, diesel and alternative fuels for motor vehicles, refining, properties, standardization, current developments Toxicology: safety and disposal, safety data sheet, legislation and regulations Special topics of Tribology: elastohydrodynamic lubrication (EHL) theory, lubrication film thickness calculations, wear calculations, special applications
Teaching and Learning Methods:	on-site teaching (lecture) exercises practical training
Assessment Method:	examination
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**60 h**
Self-study:	**90 h**
Recommended Prerequisites:	Basic knowledge of Physics, Materials Science, Chemistry, Machine Elements, Statics and Elastostatics
Recommended Reading:	*Möller, U.J.; Nassar, J.*: Schmierstoffe im Betrieb, Springer Verlag, Berlin, 2002 Further literature as well as standards, specifications and classifications will be provided in the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	06.01.2020

7.49 Virtual Product Development / CAD III

Module Code:	5240
Module Title:	Virtual Product Development / CAD III
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	once a year: in the winter semester
Person Responsible for this Module:	Prof. Dr.-Ing. Ch. Ruschitzka
Lecturers:	Prof. Dr.-Ing. Ch. Ruschitzka

Learning Outcome:	The students can apply or describe different visualization techniques, can explain and apply various numerical simulation methods for automotive engineering, can describe rapid prototyping, rapid tooling and rapid manufacturing and build and analyze digital mock-up models, can apply virtual reality methods to immersive systems (power wall), are able to simulate selected manufacturing processes and process chains for virtual product development, are able to design, select and implement suitable visualization techniques, e.g. from Virtual Reality (VR), Augmented Reality (AR) or Computer Generated Imagery (CGI).
Module Content:	Components of virtual product development: graphical visualization techniques, Finite Element Methods (FEM), Optimization Processes, NC Simulation, CFD, Virtual & Augmented Reality in Automotive Engineering, CAX Interfaces Practical application of the virtual components: automation of the development process by using features, design tables and macro programming, building of digital mock-ups including kinematics simulation, FE mesh generation, linear FEM simulation, structure and topology optimization, casting simulation, application of VR methods for high-end visualization and engineering, virtual manufacturing (NC simulation, assembly simulation, ...)
Teaching and Learning Methods:	on-site teaching (lecture) tutored exercises/practical training in the CAD and VR laboratory
Assessment Method:	examination (120 min) Alternative 1 (if requested by the participants): written exam (30 min) weighting: 25% and practical examination on the system weighting: 75 % Alternative 2 (if requested by the participants): seminar courses with several graded partial examinations The successful participation in the practical training is a prerequisite for taking the exam.
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (5 hours per week per semester):**80 h** lecture: **32 h**, practical training: **48 h**
Self-study:	**40 h (**lecture: **16 h,** practical training: **24 h)** preparation for examination: **30 h**
Recommended Prerequisites:	basic knowledge from the modules Technical Drawing and Machine Elements good CAD knowledge (CATIA V5): to be proven by a successful participation in modules CAD I and CAD II or alternatively by means of a placement test before the start of the module
Recommended Reading:	Spur/Krause: Das virtuelle Produkt, Hanser Verlag Reinertsen: Die neuen Werkzeuge der Produktentwicklung, Hanser Verlag Erlenspiel: Integrierte Produktentwicklung, Hanser Verlag Gebhardt: Rapid Prototyping, Hanser Verlag Lincke: Simultaneous Engineering, Hanser Verlag Bormann: Virtuelle Realität, Addison-Wesley Rembold: CIM: Computer Anwendungen., Addison-Wesley Note: Since the system-related literature, e.g. on CATIA, NX, HyperWorks, IC.IDO, Patchwork 3D, StarCCM+, etc., changes with each release, the current bibliography will be provided in the lecture.
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	14.08.2019

7.50 Combustion Engines

Module Code:	5126
Module Title:	Combustion Engines
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	4th/5th semester
Frequency:	twice a year: in the winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. R. Haas
Lecturers:	K. Brunnberg
Learning Outcome:	The students can describe the processes in the combustion engine from combustion to pressure build-up, can explain the importance of mean pressure and efficiency, can name the limits of efficiency, can describe the process and the meaning of the change of charge, can analyze and interpret mapping, can explain the most important properties of the fuels, can describe and compare the operating principle and function of the most important carburetion systems of the combustion engine.
Module Content:	in-depth knowledge of combustion engines engine thermodynamics thermodynamics of combustion efficiencies, medium pressure pressure diagram charge exchange fuels ignition petrol and diesel engine mixture formers petrol and diesel engine
Teaching and Learning Methods:	on-site teaching (lecture) practical training in small groups technical discussion (individual)
Assessment Method:	examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	courses (3 hours per week per semester): lecture: **48 h** (lecture: **42 h,** exercise: **6 h**)
Self-study:	student´s pre and after class preparation: **56 h** (lecture: **28 h,** exercise: **28 h**) preparation for examination: **46 h**
Recommended Prerequisites:	Basic knowledge from the modules Physics, Materials Science, Thermodynamics and Fluid Mechanics, Engineering Mathematics, Electrical Engineering, Vehicle Electrics and Electronics, Machine Elements, Driving Mechanics and Vehicle Drive Systems.

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:	
Particularities:	
Last update:	03.12.2019

7.51 Material Testing

Module Code:	5200
Module Title:	Material Testing
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	5th semester
Frequency:	once a year: in the summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. P. Krug
Lecturers:	Prof. Dr.-Ing. P. Krug
Learning Outcome:	The students know the common methods of destructive (DT) and non-destructive testing (NDT) and are able to apply these methods, are able to identify the appropriate test methods for a given complex problem and to compile the sequence of different tests, are able to evaluate the recorded measured values with regard to their reliability and to assess the informative value, know the meaning of relevant standards and are able to implement standard specifications, are familiar with standardized procedures of damage analysis and are able to apply them to new problems.
Module Content:	relationship between material structure and measuring possibilities or measured variables common methods of destructive and non-destructive material testing in the automotive industry and its suppliers evaluation of test results standardization and QA methods in material testing systematic assessment of damage events
Teaching and Learning Methods:	on-site teaching practical tests presentations (also in English) technical discussion (individual) guest lecturers
Assessment Method:	final oral examination

Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**50 h**
Self-study:	**100 h**
Recommended Prerequisites:	All compulsory modules teaching fundamentals of Mathematics, Natural Sciences and Engineering.
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)
	This elective is offered for the bachelor's program in Automotive Engineering as well as for the degree program Production and Logistics - here, the module is offered under Materials Science II (WSK II).
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.12.2019

7.52 Business Administration and Marketing

Module Code:	4020
Module Title:	Business Administration and Marketing
Type of Module:	optional module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	5th semester
Frequency:	twice a year: in the winter semester
Person Responsible for this Module:	Dr. pol. Kim
Lecturers:	Dr. pol. Kim
Learning Outcome:	The students know how to categorize the basics of business administration within the company's operations and assess economic interrelationships; they plan commercial production processes, recognize decision-relevant interrelationships in the area of financing and learn to draw up a business plan, by assigning processes to the accounting, payment flows and the corresponding flows of goods and plan and analyze the strategic orientation of companies, so that they can apply economic interrelationships in a problem-oriented manner within the scope of their industrial activities and successfully solve conflicts of interest in the course of business.

	The students formulate successful marketing strategies in the capital goods sector. They design sales structures and activities, identify influencing factors in the distribution of highly competitive product groups, by transferring the four essential influencing variables in product marketing (4Ps) and derive strategies from it, so that they successfully launch new products on the market and consolidate existing products in the course of their professional activities.
Module Content:	Marketing/fundamentals buyer behavior marketing plan as the foundation for the marketing strategy fundamentals of sales influence of operative marketing on sales Financing and investment fundamentals investment decisions financing decisions risk management Fundamentals of business administration Why do businesses exist? needs and goods economic agents principles of business management thinking and acting challenges and goals of organizations Accounting accounting principles origins and understanding of roles internal accounting system external accounting Business plan fundamentals of the business plan market analysis cost and pricing strategy processes and logistics
Teaching and Learning Methods:	The lecture imparts theoretical knowledge and activates the students through classroom assessment techniques. The 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 teamwork skills of the participants.
Assessment Method:	examination
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	**60 h** (lecture: **30 h,** exercise: **30 h**)
Self-study:	**90 h**
Recommended Prerequisites:	
Recommended Reading:	Wöhe, Günter et al. (2016); Einführung in die Allgemeine Betriebswirtschaftslehre; 26. Aufl.; München: Vahlen Straub, Thomas (2015); Einführung in die Allgemeine Betriebswirtschaftslehre; 2. Aufl.; Hallbergmoos: Pearson Eisenführ, Franz (2004); Einführung in die Allgemeine Betriebswirtschaftslehre; 4. Aufl.; Stuttgart: Schäffer-Poeschel Kotler, Philip (2016); Grundlagen des Marketing; 6. Aufl.; Hallbergmoos: Pearson Deutschland GmbH

	Bitz, Michael (Hrsg.) (2005): Vahlens Kompendium der Betriebswirtschaftslehre; 5. Aufl.; München: Vahlen Schultz, Volker (2003): Basiswissen Rechnungswesen: Buchführung, Bilanzierung, Kostenrechnung, Controlling; 3. Aufl.; München: dtv Klunzinger, Eugen (2009); Grundzüge des Gesellschaftsrechts; 15. Aufl.; München: Vahlen
Use of the Module in Other Degree Programs:	Bachelor of Mobile Work Machine, Bachelor of Energy and Building Technology, Bachelor of Rescue Engineering, Bachelor of Mechanical Engineering
Particularities:	
Last update:	10.12.2019

7.53 Practical Engineering Semester

Module Code:	940
Module Title:	Practical Engineering Semester
Type of Module:	obligatory module
ECTS Credits:	28
Language:	German
Duration of Module:	22 weeks
Recommended for Semester:	6th semester
Frequency:	in the winter and summer semester
Person Responsible for this Module:	Prof. Dr. Lenz
Lecturers:	
Learning Outcome:	The students can apply the technical knowledge acquired in the degree program to a concrete task in a problem oriented way, are able to work on practical, engineering-related topics in a team, are able to document their experiences and results in an appropriate and comprehensible manner, are able to reflect on the experiences made.
Module Content:	engineering, usually industrial, activity in the field of automotive engineering (see teaching methods) as well as in the university sector content is determined by the respective employer
Teaching and Learning Methods:	Internship in a company in the automotive industry or its suppliers, in the field of technical expertise, aerospace technology, general mechanical engineering, plant and power station construction and, in exceptional cases, other engineering disciplines (mechatronics, electrical engineering and civil engineering) in which mechanical engineering issues arise.
Assessment Method:	20-page internship semester report presentation of a 1-page certificate from the employer
Workload (25 - 30 h ≙ 1 ECTS credit):	**840 h** **22 weeks full-time**
Contact hours:	

Self-study:	
Recommended Prerequisites:	see § 25, section 2 of the examination regulations for the Bachelor Automotive Engineering
Recommended Reading:	
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.54 Key Qualifications

Module Code:	-
Module Title:	Key Qualifications
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	flexible
Recommended for Semester:	7th semester
Frequency:	winter and summer semester
Person Responsible for this Module:	Prof. Dr.-Ing. J. Blaurock
Lecturers:	Staff of the "Kompetenzwerkstatt" (competence center) and the “Sprachlernzentrum-SLZ” (language learning center)
Learning Outcome:	The students improve their ability to communicate and present, improve their ability to manage themselves, their time and studying, improve their ability to work in intercultural teams, improve their language skills.
Module Content:	The students take courses from the current internal university program of the ZaQwW (Centre for academic qualifications and continuing scientific education) on the following overarching themes. ECTS eligible courses: communication and presentation working and learning in organizations intercultural training language
Teaching and Learning Methods:	seminars workshops
Assessment Method:	proof of successful participation in the respective course
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h** Die Gesamtsumme der belegten Kurse muss mindestens 5 CTS ergeben.
Contact hours:	

Self-study:	
Recommended Prerequisites:	
Recommended Reading:	is provided in the respective seminar or workshop
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.55 Student Research Project

Module Code:	-
Module Title:	Student Research Project
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	7th semester
Frequency:	winter and summer semester
Person Responsible for this Module:	all lecturers of the Institute of Automotive Engineering
Lecturers:	all lecturers of the Institute of Automotive Engineering
Learning Outcome:	The students are able to apply the knowledge acquired in their degree program in a problem-oriented manner, are able to acquire new knowledge independently, can act in a targeted-oriented manner, are able to work independently and results-oriented within a certain time frame.
Module Content:	depends on the topic of the project
Teaching and Learning Methods:	Individual student research project with minimal input from lecturers (max. 0.4 SWS), independent work on a particular task from the field of automotive engineering.
Assessment Method:	written documentation and reflection of the results
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	
Self-study:	
Recommended Prerequisites:	
Recommended Reading:	depends on the topic of the project
Use of the Module in Other Degree Programs:	

Particularities:	
Last update:	03.12.2019

7.56 Bachelor Seminar

Module Code:	1640
Module Title:	Bachelor Seminar
Type of Module:	obligatory module
ECTS Credits:	5
Language:	German
Duration of Module:	one semester
Recommended for Semester:	7th semester
Frequency:	winter and summer semester
Person Responsible for this Module:	Prof. Dr. J. Blaurock
Lecturers:	n.a.
Learning Outcome:	The bachelor seminar is intended to enable students to orally present and independently explain the results of their bachelor's thesis, the technical basics, the interdisciplinary contexts and the non-technical references. Students acquire problem-solving competence by independently proposing solutions and evaluating them. They acquire the ability for lifelong learning through independent work and by training to carry out analysis and critical evaluations. They train presentation skills and the discussion culture.
Module Content:	In the Bachelor seminar, the criteria for a scientific presentation of an independent work which is ready for publication are taught. The students hold presentations on the objectives and the approach they used while working on her Bachelor thesis. They carry out exemplary patent and literature searches.
Teaching and Learning Methods:	seminar
Assessment Method:	presentation
Workload (25 - 30 h ≙ 1 ECTS credit):	**150 h**
Contact hours:	
Self-study:	
Recommended Prerequisites:	according to examination regulations
Recommended Reading:	
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	03.12.2019

7.57 Bachelor Thesis

Module Code:	950 960
Module Title:	Bachelor Thesis
Type of Module:	obligatory module
ECTS Credits:	12+3 (final oral examination)
Language:	German
Duration of Module:	13 weeks
Recommended for Semester:	7th semester
Frequency:	winter and summer semester
Person Responsible for this Module:	all lecturers of the Institute of Automotive Engineering
Lecturers:	all lecturers of the Institute of Automotive Engineering
Learning Outcome:	The students can work independently, are able to apply the technical knowledge acquired during their studies in a problem-oriented manner, are able to apply the scientific methods taught in the degree program, are able to think in interdisciplinary contexts, are able to organize project planning and time management independently, are able to meet deadlines, can document their results appropriately, are able to present and defend the results of their work in the final oral examination.
Module Content:	The bachelor thesis is usually an independent research project with a constructive, experimental design or other engineering task from the field of automotive engineering and an adequate description and explanation of the solution. In technically suitable cases it can also be a written term paper with technical literary content.
Teaching and Learning Methods:	independent processing of the task with minimal instruction by the lecturers
Assessment Method:	The proof consists of two elements: written documentation and reflection of the results final oral examination (presentation and defense of the results)
Workload (25 - 30 h ≙ 1 ECTS credit):	**450 h**
Contact hours:	
Self-study:	
Recommended Prerequisites:	according to the examination regulations
Recommended Reading:	depends on the topic of the project
Use of the Module in Other Degree Programs:	
Particularities:	
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