Faculty of Automotive Engineering and Production

Module Catalog
Automotive Engineering

M.Sc.

Technology
Arts Sciences
TH Köln

Content

Module Catalog | Automotive Engineering, M.Sc.

1 Program Description

The conception, development and production of modern vehicles embraces not only the function-based and cost-oriented design of components and aggregates, but also the increasingly important new technology fields, such as vehicle safety, sustainability or changed mobility behavior. The accelerating speed of technological change in the automotive industry makes disciplinary specialization a necessity to study disruptive trends, e. g. autonomous vehicles, automotive security or connectivity.

The Master´s program Automotive Engineering is defined by teaching fields in automotive innovations and systems-oriented process management, which enable students to develop vehicle systems and components for current and future demands generated by economy or society. Since automotive engineering is constantly changing and adapting to the requirements of users and the environment, the course contents of the degree program are also geared towards the ability to absorb and implement engineering innovations for automotive development throughout one's life time. This is achieved by a project-based teaching approach addressing relevant problems from the practical field.

The program comprises three semesters and concludes with the completion of the master thesis in the last of the three semesters. The program can be started either in the summer or in the winter semester. The contents of the master's program are based on the bachelor's program in Automotive Engineering or engineering programs with comparable specializations. In addition to the expansion of fundamental knowledge of methods of vehicle and vehicle component design and layout, opportunities for further specialization in specific areas of vehicle development are also offered. This enables you to build up your personal qualification profile. The close practical orientation of the lecturers to the automotive industry and the wide range of modern vehicle development laboratories ensure that you will be able to acquire excellent practical knowledge during your studies.

2 Graduate Profile

Graduates of the Master´s program M. Sc. Automotive Engineering are able to design innovative vehicle concepts, systems and components as a result of active research, tailoring of organizational structures and processes and complex problem solving in the field of automotive engineering to implement relevant economic and social requirements concerning vehicle and mobility systems.

Field of Competency *Scientificity* (K1)

Graduates are able to conduct their actions professionally based on current scientific knowledge and according to scientific conventions [in their respective fields of activity].

Field of Competency *Data Literacy* (K2)

Graduates are able to generate relevant data regarding a complex problem by experimentation, to evaluate this data and to systemize it [in their respective fields of activity].

Field of Competency *Teamwork* (K3)

Graduates are able to collaborate successfully with others [in their respective fields of activity] by using systematic communication techniques, explicit relationship management and social integration.

Field of Competency *Interdisciplinarity* (K4)

Graduates are able to integrate knowledge from a different disciplinary field to their own and to cooperate successfully in interdisciplinary teams [in their respective fields of activity] by systematic use of interface competencies, such as context-sensitive communication and disciplinary change of perspective.

Field of Competency *Technology Ethics* (K5)

Graduates are able to consider and integrate ecological, economic, social and ethical consequences of their professional actions, such as their methods, procedures and products.

Field of Competency *Critical Faculty* (K6)

Graduates are able to reflect on their professional results and their actions, to deal with professional criticism and to give constructive feedback to others regarding their professional results and their actions.

3 Fields of Activity

1. Field of Activity I: to conceptualize and innovate in the field of automotive engineering and mobility (H1)

Students are able to

- identify new problems in areas of vehicle development and production, as well as in the mobility sector, define functional requirements and provide solutions for these.
- detect available and prospective technological and mobility trends, analyze their potential and utilize these in the field of automotive engineering.

Field of Activity II: to solve problems in the field of automotive engineering and to develop vehicle systems (H2)

Students are able to…

- design vehicles for multiple market distribution.
- preserve the vehicle systems compatibility and integration of vehicle components.
- operationalize and optimize vehicle properties to influence the buyers decision process.
- develop vehicle systems, modules and components considering the automotive market change.

Field of Activity III: to plan and govern processes in vehicle development

Students are able to…

- assess vehicle systems, modules and components along the product lifecycle and to optimize these regarding environmental, economic and social sustainability.
- optimize all process phases of vehicle development considering cost efficiency, economy of time and sustainability.
- plan and govern and R&D-projects in automotive engineering.

Field of Activity IV: to solve complex technical problems in general engineering

Students are able to…

- construct diverse products while considering individual functional, economical durability and compatibility requirements.
- integrate modern production technologies, quality management procedures and CAx-techniques.

4 Study Plan

Semester	SoSe 1	WiSe 1	SoSe 2
Credit Points	**30**	**30**	**30**

Advanced Automotive Engineering	**24**	**4**	
Adv. Body Engineering and Lightweight Design	6		
Vehicle Concepts and Integration	6		
Vehicle Dynamics and Automotive Chassis	6		
Vehicle Electronics and Communication	6		
Electives (1 to be selected)		**4**	
Adv. Combustion Engines		*4*	
FEA in Body Engineering		*4*	
NVH Systems Engineering		*4*	
Adv. Vehicle Safety		*4*	

Advanced Scientific Methods	**6**	**14**	
Numerical Methods	6		
Adv. Materials - Selection and Life Cycle Assessment		6	
Electives (2 to be selected)		**8**	
Adv. Thermodynamics		*4*	
Simulation-based Production Controlling		*4*	
Optimal Control and Estimation		*4*	
Statistical Optimization		*4*	
Structural Durability		*4*	
Vehicle Dynamics Simulation		*4*	
Innovation Management		*4*	

General and Engineering Courses (2 to be selected)		**8**	
Automotive Manufacturing Processes		*4*	
Corporate Management		*4*	
Digital Factory		*4*	
Legal Requirements and Homologation		*4*	
Sustainability		*4*	
Engineering Ethics		*4*	
Automotive Supply Chain Management		*4*	

Scientific and Interdisciplinary Seminars (1 to be selected)				**4**	
Leadership Application	Scientific Seminar	Adv. Technical English-Consulting		*4*	
Component Design, Materials and Manufacture				*4*	
Virtual Reality				*4*	
Cost-Efficient Product Design				*4*	
Driver Assistance Systems				*4*	
Mobility Concepts				*4*	

Master Thesis			**30**
Thesis			30

5 Alternative Study Plan

Semester	SoSe 1	WiSe 1	SoSe 2	WiSe 2	SoSe 3
Credit Points	**18**	**12**	**18**	**12**	**30**

Advanced Automotive Engineering	**12**	**4**	**12**		
Adv. Body Engineering and Lightweight Design	6				
Vehicle Concepts and Integration	6				
Vehicle Dynamics and Automotive Chassis			6		
Vehicle Electronics and Communication			6		
Electives (1 to be selected)		**4**			
Adv. Combustion Engines		*4*			
FEA in Body Engineering		*4*			
NVH Systems Engineering		*4*			
Adv. Vehicle Safety		*4*			

Advanced Scientific Methods	**6**	**4**	**6**	**4**	
Numerical Methods	6				
Adv. Materials - Selection and Life Cycle Assessment			6		
Electives (2 to be selected)		***4***		**4**	
Adv. Thermodynamics		*4*		*4*	
Simulation-based Production Controlling		*4*		*4*	
Optimal Control and Estimation		*4*		*4*	
Statistical Optimization		*4*		*4*	
Structural Durability		*4*		*4*	
Vehicle Dynamics Simulation		*4*		*4*	
Innovation Management		*4*		*4*	

General and Engineering Courses (2 to be selected)		**4**		**4**	
Automotive Manufacturing Processes		*4*		*4*	
Corporate Management		*4*		*4*	
Digital Factory		*4*		*4*	
Legal Requirements and Homologation		*4*		*4*	
Sustainability		*4*		*4*	
Engineering Ethics		*4*		*4*	
Automotive Supply Chain Management		*4*		*4*	

Scientific and Interdisciplinary Seminars (1 to be selected)				**4**		**4**	
Leadership Application	Scientific Seminar	Adv. Technical English-Consulting		*4*		*4*	
Component Design, Materials and Manufacture				*4*		*4*	
Virtual Reality				*4*		*4*	
Cost-Efficient Product Design				*4*		*4*	
Driver Assistance Systems				*4*		*4*	
Mobility Concepts				*4*		*4*	

Master Thesis					**30**
Thesis					30

6 Module Matrix

Modulmatrix		Studiengang: M.Sc. Automotive Engineering						Fakultät: Fahrzeugsysteme und Produktion						
	Module / Lehrveranstaltungen			Handlungsfelder / Anzahl Kreditpunkte				Zuordnung Kompetenzen Absolvent*innenprofil					Prüfungen	
Lfd. Nr.	Semester	Modul		49	33,8	40,9	38,3						Anzahl	
				HF1	HF2	HF3	HF4	K1	K2	K3	K4	K5		
1	1	Advanced Body Engineering and Lightweight Design		2,5	1,5	0,8	1,2	x	x	x	x		2	
2	1	Vehicle Concepts and Integration		1,7	1,7	1,7	0,9	x	x	x		x	3	
3	1	Vehicle Dynamics and Automotive Chassis		1,9	1,9	1,3	0,9	x	x	x	x	x	3	
4	1	Vehicle Electronics and Communication		1,7	1,3	1,7	1,3	x	x	x	x	x	3	
5	1	Advanced Combustion Engines		1,8	1,1	0,6	0,5	x	x	x	x	x	1	1 to be selected
6	2	FEA in Body Engineering	one to be selected	1,5	1	0,5	1	x	x	x	x		2	
7	1	NVH Systems Engineering		1,3	1,1	0,6	1	x	x	x	x	x	1	
8	2	Advanced Vehicle Safety		1,2	1	1,2	0,6	x	x	x	x	x	3	
9	1	Numerical Methods in Engineering Sciences		0	0	0	6	x	x				1	
10	2	Advanced Materials		0,8	1,5	2,5	1,2	x	x	x	x	x	2	
11	2	Advanced Thermodynamics		1,8	1,1	0,6	0,5	x	x	x	x	x	1	2 to be selected
31	1	Simulation-based Production Controlling		1,5	0	2,5	4	x	x	x	x	x	1	
12	2	Optimal Control and Estimation		0	1	0	3						1	
13	2	Statistical Optimization	two to be selected	1	1,2	1	0,8	x	x	x	x		1	
14	2	Structural Durability		0,9	0,6	1,8	0,7	x	x		x	x	3	
15	2	Vehicle Dynamics Simulation		1,3	1,3	0,8	0,6	x	x	x	x	x	2	
32	2	Innovation Management		2	1	0,7	0,3	x	x	x	x	xx	1	
16	2	Automotive Manufacturing Processes		1,2	1,4	0,5	0,9	x	x	x	x	x	1	2 to be selected
17	2	Corporate Management		1,4	1,4	0,7	0,5	x	x	x	x	x	1	
18	2	Digital Factory		0,5	0,3	1,2	2	x	x		x		1	
19	2	Legal Requirements and Homologation	two to be selected	2	0	2	0	x	x		x	x	1	
20	2	Sustainability		1,2	0,7	1,2	0,9	x	x	x	x	x	2	
21	2	Engineering Ethics		2,3	0,9	0,8	0	x	x	x	x	x	1	
22	1	Automotive Supply Chain Management				4		x	x	x	x	x	1	
23	2	Component Design, Materials and Manufacture		1	0,9	1	1,1	x	x	x	x		1	1 to be selected
24	1	Virtual Reality		0,5	1,4	1,2	0,9	x	x		x		1	
25	2	Cost Efficient Product Design	one to be selected	1,5	1	1,5	0	x		x	x		1	
26	2	Driver Assistance Systems		3	0	1	0	x		x			2	
27	2	Mobility Concepts		4	0	0	0	x	x	x	x	x	2	
29	1/2	Scientific Seminar / Advanced Technical English						x	x	x			1	
30	3	Thesis		7,5	7,5	7,5	7,5	x	x		x	x	1	
													28	max.
		Pflichtmodule											21	min.
													22	median

7 Modules

7.1 Advanced Body Engineering and Lightweight Design

Module Code:	ABE
Module Title:	Advanced Body Engineering and Lightweight Design
Type of Module:	
ECTS Credits:	6
Language:	▪ Teaching: German ▪ Teaching material: English/German
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Frank Herrmann
Lecturers:	Prof. Dr.-Ing. Frank Herrmann
Learning Outcome:	The students are able to (WHAT) ▪ evaluate the light weight design properties and qualities of automo-tive car bodies. ▪ carry out basic engineering designs of vehicle lightweight exterior and structures, ▪ compare and evaluate design solutions for vehicle exterior and structures regarding light weight design, material application and mechanical properties, ▪ analyze and interpret structural analysis (FEM) results or ▪ analyze and interpret exterior surface properties, ▪ apply specific knowledge of advanced body materials and mechanical methods within the development process of vehicle structures and exterior surfaces by (WITH) ▪ using structural analysis (FEM) to evaluate the light weight design, ▪ employing technical surfacing based on CAS systems to evaluate the light weight design in order to (FOR) ▪ provide the necessary competencies for developing, designing and evaluating light weight car bodies in automotive industry.
Module Content:	▪ Lightweight design of vehicle structures or exterior ▪ Properties and applications of metals or fibre reinforced plastics for automotive structures or exterior ▪ Structural analysis (FEM) in vehicle structure development or ▪ Technical surfacing based on CAS systems
Teaching and Learning Methods:	▪ Software, internet and literature based self studies with integrated excercises in order to repeat or acquire specific skills and knowledges supported by teacher lectures ▪ Project based applications of specific skills and knowledges
Assessment Method:	1. Intermediate examination (90 min) 2. Assessment of project results
Workload (25 - 30 h ≙ 1 ECTS credit):	180
Contact hours:	55 h (4 SWS)
Self-study:	125 h
Recommended Prerequisites:	▪ TH Köln, BEng Fahrzeugtechnik, Lecture Karosserie or adequate knowledge in Body Engineering

Recommended Reading:	▪ Braess/Seiffert: Handbuch der Kraftfahrzeugtechnik ▪ Grabner/Nothhaft: Konstruieren von Pkw-Karosserien ▪ Dubbel: Taschenbuch für den Maschinenbau ▪ Ostermann: Anwendungstechnologie Aluminium An updated list of literature will be given in the lectures.
Use of the Module in Other Degree Programs:	-
Particularities:	-
Last update:	

7.2 Vehicle Concepts and Integration

Module Code:	VCI
Module Title:	Vehicle Concepts and Integration
Type of Module:	
ECTS Credits:	6
Language:	▪ German ▪ Teaching material and some exercise: English
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Michael Frantzen
Lecturers:	Dr.-Ing. Robert Spahl
Learning Outcome:	The students are able to (WHAT) ▪ sketch, basically design, layout, classify, judge and select new types of vehicles, ▪ justify, defend, advertise and champion their ideas of new vehicle concepts by (WITH) ▪ using package plans, sketches and CAx models and by following product development systems, in order to (FOR) ▪ meet customer wants and market needs. ▪ compare existing solutions to their new proposed ideas in terms of day-by-day usability, sustainability, power train-, chassis- and body-concepts and expected costs, based on the proposed usage ▪ develop advanced, sustainable vehicle concepts for a changing world and society.
Module Content:	▪ Introduction to vehicle concepts ▪ History of vehicle building, challenges for new vehicle concepts ▪ Introduction to vehicle design, ergonomics & package ▪ Interaction between drive train variants, body and chassis (Integration) ▪ Innovation management, research, development processes ▪ Limits of mobility, the (auto-) mobile future
Teaching and Learning Methods:	▪ Lectures with problem based integrated exercises (ProfiL²) ▪ Presentations from industry and academic partners ▪ Project work in small teams, homework, practical seminar work ▪ Simulation of development systems and processes ▪ Practical work, excursions and presentations (incl. e.g. “elevator pitch”)
Assessment Method:	1. Individual presentation 2. Group presentation 3. Project presentation and documentation of project
Workload (25 - 30 h ≙ 1 ECTS credit):	180 h
Contact hours:	41 h (3 SWS)
Self-study:	139 h
Recommended Prerequisites:	Fundamental knowledge of Vehicle Technologies in terms of Driving Dynamics, Body, Chassis & Powertrain
Recommended Reading:	▪ *Braess/Seifert:* Vieweg Handbuch Kraftfahrzeugtechnik (Vieweg) ▪ *Bosch:* Kraftfahrtechnisches Handbuch (Vieweg+Teubner)

Use of the Module in Other Degree Programs:	-
Particularities:	-
Last update:	20.09.2022

7.3 Vehicle Dynamics and Automotive Chassis

Module Code:	VDAC
Module Title:	Vehicle Dynamics and Automotive Chassis
Type of Module:	
ECTS Credits:	6
Language:	▪ Teaching: German (summary: English) ▪ Teaching material: German/English
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Dr.-Ing. Daniel Wegener
Learning Outcome:	The students are able to (WHAT) ▪ define and describe driver-oriented demands on suspension- performance of vehicles, key subsystems and components, to analyze system problems and develop solutions, ▪ compare, conclude and judge developed technical solutions based on driver, legal and environmental demands by (WITH) ▪ using/organizing project management- and simulation-tools to define, control and evaluate targets in order to (FOR) ▪ address a complex technical challenge in automotive engineering
Module Content:	▪ Methods to describe and evaluate vehicle motions ▪ Identification of driver-oriented-, functional-, legal- and environmental-based demands on vehicle dynamics, suspension subsystems, components and the total vehicle ▪ Integration of developed solutions to specified total vehicle concept
Teaching and Learning Methods:	▪ Lectures ▪ presentations given by external industry experts ▪ Project work in small teams including presentations and discussions
Assessment Method:	1. Written examination (90 min) 2. project documentation 3. individual presentation
Workload (25 - 30 h ≙ 1 ECTS credit):	180 h
Contact hours:	89 h (6,5 SWS)
Self-study:	91 h
Recommended Prerequisites:	Vehicle dynamics, basics of automotive chassis
Recommended Reading:	▪ *Breuer, B.; Bill, K.-H.:* Bremsenhandbuch, Heidelberg-, Springer Verlag, 4. Aufl, 2013 ▪ *Heißing, Bernd, Ersoy, Metin, Gies, Stefan (Hrsg.):* Fahrwerkhandbuch, Heidelberg, Springer-Verlag, 4. Aufl, 2013 ▪ *Matschinsky, Wolfgang: Radführung der Strassenfahrzeuge. Heidelberg, Springer-Verlag, 2007* ▪ *Reimpell, J.; Stoll, H.; Betzler, J.:* The Automotive Chassis: Engineering Principles, Lodon, Butterworth and Heinemann, 2000 ▪ *Winner, H., Hakuli, S., Lotz, F., Singer, C. (Hrsg.):* Handbuch Fahrerassistenzsysteme, Springer Verlag Heidelberg, 3. Aufl. 2015

	Add. literature and legal regulations specified in the lectures.
Use of the Module in Other Degree Programs:	-
Particularities:	-
Last update:	

7.4 Vehicle Electronics and Communication

Module Code:	VEC
Module Title:	Vehicle Electronics and Communication
Type of Module:	
ECTS Credits:	6
Language:	German/English
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Prof. Dr.-Ing. Toni Viscido
Learning Outcome:	The students are able to (WHAT) ▪ describe, design and to specify automotive electronic control systems according to recent to State-of-the-Art knowledge, ▪ identify and to adapt to future trends, ▪ explain behavior, possible system limits and failures ▪ develop new electronically controlled systems by (WITH) ▪ using package plans, specifications, sketches, datasheets and by product development tools and innovation methods in order to (FOR) ▪ meet customer expectations and market requirements ▪ compare existing solutions to new ideas in terms of day-by-day usability, sustainability, expected costs and possible technical, ecological and economical realization ▪ develop advanced connected innovations for changing mobility
Module Content:	▪ Electronic systems in vehicles ▪ Automotive data technology ▪ X-by-wire systems ▪ Bus-systems ▪ EMV/EMS ▪ Electrical power supply ▪ Electronic drives and hybrid systems
Teaching and Learning Methods:	▪ Lectures ▪ Seminars
Assessment Method:	1. Individual presentation 2. Group presentation 3. Project presentation and documentation of project
Workload (25 - 30 h ≙ 1 ECTS credit):	180 h
Contact hours:	69 h (5 SWS)
Self-study:	111 h
Recommended Prerequisites:	Fundamental knowledge of vehicle electrics, physics, combustion engines, vehicle dynamics and automotive chassis, numerical methods in engineering sciences, mechatronic system for automotive applications

Recommended Reading:	▪ *Streichert, T.; Traub, M.:* Elektrik/Elektronik-Architekturen im Kraftfahrzeug. VDI/Springer, 2012 ▪ *Reif, K.:* Batterien, Bordnetze und Vernetzung. Vieweg und Teubner, 2010
Use of the Module in Other Degree Programs:	-
Particularities:	-
Last update:	

7.5 Advanced Combustion Engines

Module Code:	ACE
Module Title:	Advanced Combustion Engines
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching material: English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Kai-Uwe Münch
Lecturers:	Prof. Dr.-Ing. Kai-Uwe Münch
Learning Outcome:	The students are able to (WHAT) ▪ describe and discriminate the several systems of supercharging in function and basic knowledge, ▪ describe and explain the coherences and technology of the piston engine including using the theoretical background, ▪ know alternative fuels and sources (illustrate the methods of mass balancing, design a mass balancing, by (WITH) ▪ analyzing and explaining the gas- and mass forces of the engine, ▪ analyzing hybridization advantages of the Power train, ▪ designing a mass balancing in order to (FOR) ▪ develop advanced combustion engines.
Module Content:	▪ Supercharging of engines (turbocharging, resonance charging, variable length intake manifolds, compressors) ▪ Downsizing ▪ Exhaust emissions and emission control systems (forces inside the engine, mass balancing) ▪ Engine torque ▪ Torque fluctuations (rotational vibrations) ▪ Hybridization of the power train
Teaching and Learning Methods:	▪ Lecture ▪ Exercises ▪ Presentation ▪ (Practical training on engines in small groups)
Assessment Method:	1. Written examination (120 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120 h
Contact hours:	41 h (3 SWS)
Self-study:	79 h
Recommended Prerequisites:	▪ Physics, chemistry, thermodynamics, mathematics, statics, dynamics, material science, electrical engineering, vehicle driving mechanics
Recommended Reading:	▪ Internal Combustion Engine Handbook, SAE ▪ *Robert Bosch GmbH:* Automotive Handbook, Düsseldorf, VDI Verlag, 1991

	▪ SAE technical Papers for up-to-date publications
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.6 FEA in Body Engineering

Module Code:	FEx
Module Title:	FEA in Body Engineering
Type of Module:	
ECTS Credits:	6
Language:	▪ Teaching: German ▪ Teaching material: English/German
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Frank Herrmann
Lecturers:	Prof. Dr.-Ing. Frank Herrmann
Learning Outcome:	The students are able to (WHAT) ▪ understand metal plasticity and behaviour of vehicle structures beyond material yielding ▪ analyze and evaluate car crash/ crush events or car sheet metal forming processes based on nonlinear finite element methods (FEM) by (WITH) ▪ using nonlinear finite element code Abaqus to treat - Nonlinearities in FEM: material plasticity, nonlinear geometry and contact - Crush and crash of vehicle substructures or sheet metal forming processes - Quasistatic implicit FEM - Dynamic explicit FEM - Material failure criteria and structural failure modes ▪ applying nonlinear FEM to typical crush and crash problems of automotive structures in order to (FOR) ▪ perform nonlinear finite element analysis as a major development tool in car body engineering
Module Content:	▪ Nonlinearities in FEM: material plasticity, nonlinear geometry and contact ▪ Crush and crash of vehicle substructures ▪ Quasistatic implicit FEM ▪ Dynamic explicit FEM ▪ Material failure criteria and structural failure modes
Teaching and Learning Methods:	Lectures with computer exercises, Application of FEM code Abaqus at the computer lab of the faculty
Assessment Method:	1. Written examination ([xx] min) 2. FEM problem to be solved on the computer (270 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120 h
Contact hours:	41 h (3 SWS)
Self-study:	79 h
Recommended Prerequisites:	Mandatory prerequisites are • TH Köln, BEng Fahrzeugtechnik, Lecture FEM Leichtbau or • Valid basic knowledge in FEM software Abaqus If prerequisites are not given students can join TH Köln, BEng Fahrzeugtechnik, Lecture FEM Leichtbau prior to join FEA in Body Engineering

Recommended Reading:	▪ Dassault Systemes SIMULIA Abaqus Student Edition, Abaqus Documentation, 2020 ▪ F. Herrmann, BEng Fahrzeugtechnik - Vorlesung FEM Leichtbau. Köln, 2020. [Online]. Verfügbar unter: https://youtu.be/EC94ucgk_c0, https://youtu.be/Wb3Ouu4F1VE, https://youtu.be/Zbawdaz9ETo, https://youtu.be/Y-L2R98Bfd0, https://y-outu.be/3r1lQOZkRjM, https://youtu.be/5gF3KOv2T-o, https://youtu.be/rGmoOeLyQLg, https://youtu.be/XlQu7DESeuw, https://youtu.be/7C9MqbU-ODg
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.7 NVH Systems Engineering

Module Code:	NVH
Module Title:	NVH Systems Engineering
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German / English ▪ Teaching materials: German / English ▪ Software: English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Rainer Haas
Lecturers:	Prof. Dr.-Ing. Rainer Haas
Learning Outcome:	The students are able to (WHAT) ▪ apply state-of-the-art process-oriented methodologies and tools in NVH development by (WITH) ▪ by analyzing a given automotive NVH issue based on a structured self-generated work plan containing necessary calculations and/or measurements including execution and evaluation in order to (FOR) ▪ to explain causes scientifically, define target attributes and develop appropriate solutions and possibly implement them.
Module Content:	▪ advanced mechanical vibrations ▪ advanced acoustics ▪ advanced measurements and signal analysis ▪ computer-based tools in NVH development
Teaching and Learning Methods:	Lecture with focus on NVH (mechanics, acoustics, signal analysis) of automotive systems. Case-study based project work with special focus on state-of-the-art topics. Use of e-learning system for distribution of course material and actual lecture notes
Assessment Method:	1. group project (individual continuous assessment of project work including documentation and final presentation)
Workload (25 - 30 h ≙ 1 ECTS credit):	120 h
Contact hours:	28 h (2 SWS)
Self-study:	92 h
Recommended Prerequisites:	continuous assessment of Project work including documentation presentation and colloquium
Recommended Reading:	▪ Fahy, F.: Sound and Structural Vibration - Radiation, Transmission and Response, London, Academic Press, 1998 ▪ Freymann, R.: Advanced Numerical and Experimental Methods in the Field of Vehicle Structural-Acoustics, Habilitationsschrift, TU-München, München, Hieronimus, 2000 ▪ Newland, D.E.: Random Vibrations, Spectral & Wavelet Analysis, Harlow, Langman, 1997 ▪ Rao, S.: Mechanical Vibrations, Singapore, Pearson Education, 2004 Further Literature see detailed reference list in script.

Use of the Module in Other Degree Programs:	
Particularities:	problem based learning
Last update:	26.10.2020

7.8 Advanced Vehicle Safety

Module Code:	AVS
Module Title:	Advanced Vehicle Safety
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching materials: German/English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Prof. Dr.-Ing. Toni Viscido
Learning Outcome:	The students are able to (WHAT) ▪ describe requirements to modern car design concerning safety, ▪ understand the critical issues concerning active and passive safety protection, ▪ understand the engineering solutions to protect humans inside and outside the vehicle in the event of a crash by (WITH) ▪ analyzing a defined vehicle safety issue or task based on a structured self-defined work structure and methods ▪ assessment of existing solutions and derivation of new functions and technologies in order to (FOR) ▪ explain causes scientifically, define target attributes and develop appropriate engineering solutions
Module Content:	▪ Principles of road and vehicle safety ▪ Vehicle safety systems and crashworthiness ▪ Active and passive safety ▪ Crash modes and structural design requirements ▪ Crash investigation, driver behavior and safety
Teaching and Learning Methods:	▪ Lectures ▪ Exercises
Assessment Method:	1. Individual presentation 2. Group presentation 3. Project presentation and documentation of project
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (3 SWS)
Self-study:	79
Recommended Prerequisites:	Fundamental knowledge about car design and automotive engineering
Recommended Reading:	▪ *F. Kramer*: Automotive Passive Safety, Vieweg-Teubner Verlag, 1998 ▪ *H.-H. Braess, U. Seiffert*; Automotive Handbook, Vieweg-Teubner Verlag, 2012 Further literature will be recommended relating to the individual subjects.
Use of the Module in Other Degree Programs:	

Particularities:	-
Last update:	

7.9 Numerical Methods in Engineering Sciences

Module Code:	NM
Module Title:	Numerical Methods in Engineering Sciences
Type of Module:	
ECTS Credits:	6
Language:	Teaching: German Teaching Material: German/English
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr. Georg Engelmann
Lecturers:	Prof. Dr. Georg Engelmann
Learning Outcome:	The students are able to (WHAT) ▪ analyze and evaluate numerical methods with regard to their performance and limitations as well as their areas of application ▪ develop programs in Julia or Matlab and apply numerical methods themselves ▪ assess the results obtaines in this way by (WITH) ▪ applying important principles and methods of numerical mathematics for use in engineering sciences in order to (FOR) ▪ select, if necessary further develop and use suitable numerical methods for engineering application problems.
Module Content:	▪ Principles and methods of the main fields of scientific computing, e.g. ▪ solution of linear systems ▪ eigenvalue problems ▪ singular value decomposition ▪ interpolation, quadrature ▪ solution of initial value problems
Teaching and Learning Methods:	▪ Self-study texts will be distributed weekly in preparation for the lectures ▪ Exercises and programming tasks with Julia or Matlab
Assessment Method:	Written examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	180 h
Contact hours:	Minimum 42 h (3 SWS)
Self-study:	Maximum 158 h

Recommended Prerequisites:	▪ Good knowledge in linear algebra (and analysis). ▪ Good programming skills in Matlab or Julia. ▪ For more information at ILIAS (For TH Köln members only)
Recommended Reading:	C. Moler: Numerical Computation with Matlab, SIAM 2004, Philadelphia (Download 2022: https://de.mathworks.com/moler.html, for introduction) A. Quarteroni, R. Sacco, P. Gervasio: Scientific Computation with Matlab and Octave, Springer, Heidelberg, 2014 G. Strang: Introduction to Linear Algebra, Wellesley – Cambridge Press, Wellesley (Mass.), 2009 Informationen about Julia: https://julialang.org, Informationen about Matlab: https://de.mathworks.com/
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	01.12.2022

7.10 Advanced Materials

Module Code:	AM
Module Title:	Advanced Materials
Type of Module:	
ECTS Credits:	6
Language:	▪ English/German lecture notes and slides, German/English language
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Peter Krug
Lecturers:	Prof. Dr.-Ing. Peter Krug, Prof. Dr. rer. nat. Johannes Stollenwerk
Learning Outcome:e	The students are able to (WHAT) ▪ explain and apply the physical, material and manufacturing aspects of modern materials, describe aspects of recycling and ecological auditing, explain and distinguish between surface engineering technologies to improve material properties and durability, illustrate and compare modern production processes, analyze complex requirement. evolve material-related strategies for typical management issues, by (WITH) ▪ critical assessment of external strategies, practice team work and project management in order to (FOR) ▪ evolve strategies and conduct complete life cycle assessment on specific, complex automotive components, to elaborate different solutions for complex problems with various constraints and contradicting objectives.
Module Content:	Advanced materials and manufacturing technologies with emphasis on automotive applications: ▪ material science ▪ materials selection methods ▪ light weight design ▪ primary production of materials ▪ sensor materials ▪ materials for e-mobility ▪ surface engineering ▪ production processes of components ▪ process analysis ▪ sustainability ▪ carbon footprint ▪ life cycle assessment
Teaching and Learning Methods:	Lectures and invited speakers from industry Home exercises (micro projects) Discussion (plenum or individual) Student´s presentations Excursion
Assessment Method:	1. Written examination (120 min) 2. Oral presentation within colloquium
Workload (25 - 30 h ≙ 1 ECTS credit):	180h
Contact hours:	69 h (5 SWS)
Self-study:	111 h

Recommended Prerequisites:	Basics in material science, manufacturing technologies and economics. Fundamentals in automotive engineering.
Recommended Reading:	▪ Tipler: Physics for scientists and engineers, Worth Publisher, Inc., New York, 1991 ▪ Maissel, G.: Handbook of thin film technology, McGraw-Hill. Inc., 1983 ▪ Cebon, D; Ashby, M.: Case studies in Materials Selection; Butterworth 1996 ▪ Mikell, P., G.: Fundamentals of modern manufacturing: Materials, Processes and Systems, 3rd edition, publisher: Wiley, 2006
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.11 Advanced Thermodynamics

Module Code:	ATD
Module Title:	Advanced Thermodynamics
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching materials: English / German
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Kai-Uwe Münch
Lecturers:	Prof. Dr.-Ing. Kai-Uwe Münch
Learning Outcome:	The students are able to (WHAT) ▪ explain the fundamentals in technical combustion, humid air and air conditioning, ▪ describe and explain convective heat transfer, ▪ describe and explain unsteady heat transfer phenomena by (WITH) ▪ check behaviour of convective heat transfer ▪ in order to (FOR) ▪ evaluate unsteady heat transfer phenomena
Module Content:	▪ Unsteady heat transfer ▪ humid air and air conditioning ▪ introduction in technical combustion (main focus on reciprocating engine combustion): fuel atomization, mixture formation, ignition, premixed and diffusion combustion, emission generation mechanism
Teaching and Learning Methods:	▪ Lectures ▪ Exercise courses
Assessment Method:	1. Written examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65
Recommended Prerequisites:	Higher mathematics, basic lectures thermodynamics and fluid dynamics
Recommended Reading:	▪ Kuo, K.K.: Principles of combustion, Wiley & Sons, New York ▪ Baehr, H.D.: Thermodynamik, Springer, Berlin, Heidelberg
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.12 Simulation-based Production Controlling

Module Code:	SPC
Module Title:	Simulation-based Production Controlling
Type of Module:	
ECTS Credits:	4
Language:	Teaching: German Teaching Material: German/English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr. rer. oec. Markus Pütz
Lecturers:	Prof. Dr. rer. oec. Markus Pütz
Learning Outcome:	Students are able to ▪ model, analyze and design relevant potential and process structures in production controlling in the application context of Automotive Engineering using simulation, by ▪ understanding the relevant technical terms, principles, concepts, procedures and instruments of Production Controlling, in particular the methodology of Open Decision Networks and simulation technology, with special consideration of the simulation system Simio, and by successfully applying them in a target-appropriate and solution-oriented manner in exercises and case studies relevant to Automotive Engineering, in order to ▪ be able to analyze and successfully fulfill basic tasks and projects of Simulation-based Production Controlling in the typical application context of Automotive Engineering or at least to effectively support the respective fulfillment.
Module Content:	▪ Basic aspects of Production Controlling ▪ Introduction to Open Decision Networks (ODN) ▪ Methods for the design and analysis of ODN ▪ Simulation-based ODN ▪ Crash course: Advanced aspects of simulation technology ▪ Introduction to simulation with Simio ▪ My first simulation project ▪ Case studies on Simulation-based Production Controlling

Teaching and Learning Methods:	▪ Lectures ▪ Demonstration and explanation of simulation model programming examples ▪ Exercises and case studies
Assessment Method:	Written examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120
Contact hours:	41 h (3 SWS)
Self-study:	79 h
Recommended Prerequisites:	Good knowledge of project management and descriptive statistics, basic programming skills.
Recommended Reading:	▪ Küpper, Hans-Ulrich; Friedl, Gunther; Hofmann, Christian; Hofmann, Yvette; Pedell, Burkhard: Controlling: Konzeption, Aufgaben, Instrumente. 6. Aufl., Stuttgart: Schäffer Poeschel 2013 ▪ Pritsker, A. Alan B.; Happ, W. William: GERT: Graphical Evaluation and Review Technique. Part I - Fundamentals. In: Journal of Industrial Engineering, Vol. 17 (1966), No. 5, S. 267-274 ▪ Pütz, Markus: Operativ-gestütztes strategisches Controlling flexibel automatisierter Produktionssysteme. 1. Halbband: Theoretische Grundlagen und Basiskonzeption; 2. Halbband: Fallstudie: Lohmar – Köln 2004 ▪ Smith, Jeffrey S.; Sturrock, David T.; Kelton, W. David: Simio and Simulation: Modeling, Analysis, Applications, 5. Aufl., 2018 ▪ Steven, Marion: Produktionscontrolling, Stuttgart: Kohlhammer 2016 Further course related literature (e.g. books, journal papers) may be indicated during the course.
Use of the Module in Other Degree Programs:	
Particularities:	After successful completion of the SPC module, students receive a certificate from TH Köln for the successful acquisition of basic knowledge in the Simio simulation system following their active participation in the sessions of this module in the semester attended.
Last update:	29.02.2024

7.13 Optimal Control and Estimation

Module Code:	OCE
Module Title:	Optimal Control and Estimation
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching material: lecture notes in German, programming examples in English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	N.N.
Learning Outcome:	The students are able to (WHAT) ▪ apply advanced knowledge of state-space control systems with reference- and disturbance-feedforward, ▪ describe, explain and apply the design of optimal linear state-space control systems by means of optimizing quadratic cost functions for deterministic and stochastic stimuli, ▪ describe, explain and apply an approach for robust implementation, ▪ independently continue their education using further literature by (WITH) ▪ by evaluating sophisticated publications of control engineering and by applying the methods of optimal control and estimation to mechatronic use cases in order to (FOR) ▪ design and develop optimal controls for complex mechatronic systems for applications in industry or research
Module Content:	Linear, quadratic, Gaussian (LQG) state-space control: ▪ fundamentals of the analysis of stochastic signals ▪ linear quadratic regulator (LQR) design ▪ linear quadratic estimator (LQE) design ▪ plant model augmentations for reference- and disturbance feedforward and disturbance estimation ▪ robust implementation by loop transfer recovery (LTR) ▪ Tool-supported design and implementation of an optimal state-space control for an electromechanical positioning system
Teaching and Learning Methods:	▪ Seminaristic lectures ▪ Demonstration and explanation of programming examples ▪ Self-studies to work out certain topics of the course ▪ Demonstration of application examples with laboratory test rigs
Assessment Method:	1. Written examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h
Recommended Prerequisites:	Good knowledge of the lecture control system design, Good knowledge in linear algebra and analysis

Recommended Reading:	▪ O. Föllinger et. al.: Regelungstechnik – Einführung in die Methoden und ihre Anwendung. 10. Auflage, Hüthig Buch Verlag 2008 ▪ B. Friedland: Control System Design – An Introduction to State-space methods. Dover Pubn Inc 2005 Further Literature see also the literature list at the lecture notes.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.14 Statistical Optimization

Module Code:	SO
Module Title:	Statistical Optimization
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching material: German and English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr. rer.nat.habil. Rainer Lenz
Lecturers:	Prof. Dr. rer.nat.habil. Rainer Lenz
Learning Outcome:	The students are able to (WHAT) ▪ solve concrete problems of statistical optimization by (WITH) ▪ by adapting suitable mathematical models and choosing efficient methods of linear and non-linear optimization in order to (FOR) ▪ solve real complex problems in industry efficiently regarding time and cost expenditure.
Module Content:	Principles and methods of the main fields of Statistical Optimization: ▪ e.g. Probability and statistics ▪ methods of linear and combinatorial optimization ▪ workflow optimization ▪ selected application examples ▪ robust optimization
Teaching and Learning Methods:	▪ Seminaristic lectures ▪ Self studies to work out certain topics of the course ▪ Exercises and practical training
Assessment Method:	1. Written examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h
Recommended Prerequisites:	Good knowledge in linear algebra, analysis and descriptive statistics. Basic programming skills
Recommended Reading:	▪ *E. Kreyszig:* Advanced Engineering Mathematics, John Wiley & Sons, INC., Asia, 2011 ▪ *A. Koop:* Lineare Optimierung, Spektrum – Akad. Verlag, Berlin 2008 ▪ *Papadimitriou, C.H., Steiglitz, K.:* Combinatorial Optimization: Algorithms and Complexity, Dover Books on Computer Science, 2000
Use of the Module in Other Degree Programs:	
Particularities:	-

Last update:

7.15 Structural Durability

Module Code:	SD
Module Title:	Structural Durability
Type of Module:	
ECTS Credits:	4
Language:	English/German lecture notes and slides, English/German language
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Peter Krug
Lecturers:	Prof. Dr.-Ing. Peter Krug, Martin Schlupek
Learning Outcome:	The students are able to (WHAT) ▪ explain different methods to improve structural durability in detail, ▪ describe and explain the influencing factors on strength and fracture behavior, ▪ understand impact on component´s failure mode, ▪ identify failure mechanisms by (WITH) ▪ analyzing and comparing different load spectra ▪ critically assessing complex mechanical or environmental loadings of components ▪ analyzing and comparing publications on structural durability and component´s failure in order to (FOR) ▪ perceive the impact on component´s failure mode ▪ draw right conclusions from journal papers on structural durability and component´s failure, ▪ improve given material and design with respect to durability demands ▪ enable examination of different materials and/or different treated materials ▪ perform lifetime predictions and develop complete structural durability verifications/ validations.
Module Content:	▪ fatigue in different materials ▪ structural durability ▪ failure mechanisms ▪ technical failures ▪ fracture mechanics ▪ influencing factors on strength and fracture behavior ▪ influence of tribology, corrosion
Teaching and Learning Methods:	Lectures Exercises Laboratory work Reading and discussion of relevant journal papers (plenum or individual) Oral presentation by students
Assessment Method:	1. Groupwise oral presentation of group project with colloquium (30-45 min) 2. Oral presentation of single project with colloquium (20 min) 3. Written examination (45 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h

Recommended Prerequisites:	Materials science, mathematics, mechanical design, requirements and boundary conditions of automotive components in service
Recommended Reading:	▪ *Cebon, D.; Ashby, M.:* Case studies in Materials Selection; Butterworth 1996 ▪ *Haibach, E.:* Betriebsfestigkeit- Verfahren und Daten zur Bauteilberechnung, Springer 2006 ▪ *Schmitt-Thomas, K. G.:* Integrierte Schadenanalyse Technikgestaltung und das System des Versagens, Springer 2005
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	21.03.2021

7.16 Vehicle Dynamics Simulation

Module Code:	VDS
Module Title:	Vehicle Dynamics Simulation
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching : German (summary: English) ▪ Teaching material: German/English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	N.N.
Learning Outcome:	The students are able to (WHAT) ▪ define driver oriented demands on the performance of suspension systems and vehicle dynamics, ▪ analyze the properties of the suspension system and of the vehicle dynamics performance, ▪ identify problems and develop solutions, ▪ compare, conclude and judge developed technical solutions based on simulation results by (WITH) ▪ using simulation tools to define, control and evaluate targets in ordert o (FOR) ▪ to address complex technical challenges and trade-offs in the field of vehicle dynamics.
Module Content:	Parametric and Multi-Body-CAE-tools to simulate the kinematics of suspension systems and the total vehicle dynamics: GIM, VeDySim, ADAMS Standardized vehicle dynamic open and closed loop tests Validation and interpretation of simulated results
Teaching and Learning Methods:	▪ Seminars ▪ Project based applications of specific skills and knowledges
Assessment Method:	1. project documentation 2. individual presentation
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h
Recommended Prerequisites:	Vehicle dynamics, basics of automotive chassis, basics of CAE tools
Recommended Reading:	▪ *Robert Bosch GmbH:* KraftfahrzeugtechnischesTaschenbuch, Heideberg, Springer-Verlag, 28. Aufl. 2014 ▪ *Heißing, Bernd, Ersoy, Metin, Gies, Stefan (Hrsg.):* Fahrwerkhandbuch, Heidelberg, Springer-Verlag, 4. Aufl, 2013 ▪ *Reimpell, J.; Betzler, J.W.:* Fahrwerktechnik: Grundlagen 5. Aufl. Würzburg, Vogel Buchverlag, 2005

	▪ *Reimpell, J.; Stoll, H.; Betzler, J.:* The Automotive Chassis: Engineering Pronciples, Lodon, Butterworth and Heinemann, 2000 Add. literature and legal regulations specified in the lectures.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.17 Innovation Management

Module Code:	IM
Module Title:	Innovation Management
Type of Module:	
ECTS Credits:	4
Language:	– Teaching: German, English on request – Teaching material: German
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Ralf Breede
Lecturers:	Prof. Dr.-Ing. Ralf Breede
Learning Outcome:	Students are able to (WHAT) – analyze, evaluate and improve the situation, culture and outcome of an environment (company, center, department, team), including the supporting processes, regarding its innovative ability by (WITH) – the analysis and assessment using suitable tools and methods of a progressive technology- and innovation management and by generating improving ideas using creativity methods in order to (FOR) – tear down innovation constraints and to realize/optimize a supporting culture for the different types of innovation (product, process, social, structure, marketing, business model) either to enhance existing environments or to define creative solutions in early product planning phases as well as along the full product life cycle
Module Content:	– Introduction into the fundamentals of Innovation Management – Specific techniques and methods of Innovation Management – Project management methods / creativity techniques – Project work to specific topics
Teaching and Learning Methods:	– Lectures – Workshops – Project work in small teams – Presentations
Assessment Method:	Project report with presentation and/or written exam
Workload	120h

(25 - 30 h ≙ 1 ECTS credit):

Contact hours:	41 h (3 SWS)
Self-study:	79 h
Recommended Prerequisites:	Knowledge of project management, engineering methods along a product life cycle
Recommended Reading:	– Disselkamp, M.: Innovationsmanagement: Instrumente und Methoden zur Umsetzung in Unternehmen. Springer Gabler 2012 – Schäperkötter, H.: Grundlagen des Innovationsmanagements: Orientierung und Anregungen für Praktiker (essentials). Springer Gabler 2022 Further literature will be recommended relating to the subject within the lectures.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	08/2023

7.18 Automotive Manufacturing Processes

Module Code:	AMP
Module Title:	Automotive Manufacturing Processes
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German/English ▪ Teaching material: English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Christoph Hartl
Lecturers:	Prof. Dr.-Ing. Christoph Hartl
Learning Outcome:	The students are able to (WHAT) ▪ are able to make a suitable material- and application-related selection of manufacturing processes and sequences for a manufacturing task from industrial production for vehicle construction taking into account sustainability and economic efficiency by (WITH) ▪ applying the knowledge they have acquired on the technical process options and the relationships between production processes and the factors of cost, time and quality, intensified within the framework of the module lectures, among others, through analyses of practical examples in order to (FOR) ▪ enable students to decide on technically feasible and economically applicable manufacturing processes and production chains in areas of employment such as vehicle design, component development, production or production planning.
Module Content:	Fundamentals and applications of manufacturing technologies and process chains used for manufacturing and processing of metallic and non-metallic materials (polymers, glass, ceramics), and composite materials related to automotive production from the fields of casting, forming, sintering, joining, coating, microsystem component manufacturing and additive manufacturing.
Teaching and Learning Methods:	▪ Lectures ▪ Exercises
Assessment Method:	1. Written examination (90 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (3 SWS)
Self-study:	79h
Recommended Prerequisites:	Knowledge in material sciences, engineering mechanics, physics and mathematics
Recommended Reading:	▪ Groover, M.P.: Principles of Modern Manufacturing, Singapore; Hoboken, New Jersey: John Wiley & Sons Ltd., 2016 ▪ Henning, F., Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. München: Hanser, 2020. Further literature will be recommended relating to the individual subjects.

Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.19 Corporate Management

Module Code:	CM
Module Title:	Corporate Management
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching material: English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	Prof. Dr.-Ing. Michael Matoni
Learning Outcome:	The students are able to (WHAT) ▪ analyse specialities of strategic basics in automotive business, ▪ arrange the different strategic approach of international acting enterprises with fundamentals of marketing management, ▪ know how to synthesize strategic management situation by (WITH) ▪ complying the techniques for analyzing industries and competitors, ▪ using business terms and concepts when communicating ▪ applying leadership models ▪ combine aspects for questioning to leadership, in order to (FOR) ▪ deploy corporate strategies specifically adapted to technical and social aspects in automotive business.
Module Content:	General Strategic Management: ▪ Process of leadership and executive function ▪ corporate strategy of OEM / international aspects of automotive business / marketing Management / management tools: make -or-buy, flexibility, cots, business and operating models
Teaching and Learning Methods:	▪ Lectures ▪ Exercises ▪ Project work / case studies ▪ Presentation and discussion of individual project work
Assessment Method:	1. Project Thesis
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (4 SWS)
Self-study:	79 h
Recommended Prerequisites:	Basics in Economics and Marketing
Recommended Reading:	▪ *Ebel, Hofer, Al-sibai:* Automotive Management, Springer Verlag 2003 ▪ *Clarke:* Automotive Production Systems and Standardisation, Physika Verlag, 2005 ▪ *Heneric:* Europe´s Auromotive Industry on the move, Physika Verlag, 2005

Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	21.09.2022

7.20 Digital Factory

Module Code:	DiFa
Module Title:	Digital Factory
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German, English on request ▪ Teaching material: English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Ralf Breede
Lecturers:	Prof. Dr.-Ing. Ralf Breede
Learning Outcome:	Students are able to (WHAT) ▪ analyze and evaluate the main objectives, as well as the methods and fields of application of a digital factory as well as future smart factories by (WITH) ▪ conscious and integrated implementation of digital methods, modelling and simulation techniques in order to (FOR) ▪ enable them to do a systematic analysis of complex planning situations and the development of solution-oriented concepts as part of the product development process.
Module Content:	Methods and tools for digital planning and continuous optimization of industrial production environments with an emphasis on automotive production processes in terms of a digital and smart factory.
Teaching and Learning Methods:	▪ Lectures ▪ Exercises / Project work in small teams ▪ Presentations
Assessment Method:	Project report with presentation and/or written exam
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (3 SWS)

Self-study:	79 h
Recommended Prerequisites:	▪ Knowledge of production processes and techniques, production organization, manufacturing principles and automation ▪ Fundamentals of 3D-CAD/CAE-systems
Recommended Reading:	▪ *Bracht, U.; Geckler, D.; Wenzel, S.:* Digitale Fabrik - Methoden und Praxisbeispiele. Springer, 2018 ▪ *Kühn, W.:* Digitale Fabrik - Fabriksimulation für Produktionsplaner. Hanser, 2006 Further literature will be recommended relating to the subject within the lectures.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	08/2023

7.21 Legal Requirements and Homologation

Module Code:	LRH
Module Title:	Legal Requirements and Homologation
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German ▪ Teaching material: German
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	N.N.
Learning Outcome:	Students are able to (WHAT) ▪ analyze and implement legal requirements related to the technical market release of a vehicle by (WITH) ▪ understanding the basic core issues in global vehicle homologation, ▪ identifying specific problem definitions related to legal requirements and homologation, ▪ practicing specialization in country-specific standards and regulations, in order to (FOR) ▪ take these issues into account in their role in vehicle development and to participate in homologation processes.
Module Content:	The module is focused on processes, boundary conditions and regulations which have to be considered to certify the roadworthy of vehicles on global markets. Selected country-specific standards and regulations which impact vehicle homologation will be highlighted.
Teaching and Learning Methods:	Lectures, Exercises, Oral presentation by students
Assessment Method:	1. Written examination (60 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (3 SWS)
Self-study:	79 h
Recommended Prerequisites:	No specific requirements
Recommended Reading:	▪ *Siebert et.al.*: Das Typgenehmigungsverfahren für Kraftfahrzeuge, Kirschbaum, 2019 ▪ *Verordnung (EU) 2018/858*: Genehmigung und die Marktüberwachung von Kraftfahrzeugen und Kraftfahrzeuganhängern sowie Zubehör, EU, 2018 Further literature will be recommended relating to the subject within the lectures.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.22 Sustainability

Module Code:	SUT
Module Title:	Sustainability
Type of Module:	
ECTS Credits:	4
Language:	– Teaching: German – Teaching material: German/English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr. rer. nat. Kathrin Hesse
Lecturers:	Prof. Dr. rer. nat. Kathrin Hesse
Learning Outcome:	Students are able to (WHAT) – independently describe relevant project tasks with a focus on sustainable for product design and automotive components, develop alternative scenario procedures and make decisions by (WITH) independently assessing results of current challenges of the progressive use of technology in the automotive industry (incl. trends like Industry 4.0, environmental assessment, etc.) in order to (FOR) – re-conceptualize essential areas in order to evaluate the generated solutions with regard to their sustainability within the technical conception.
Module Content:	– Product development with focus on environmental issues – Detection of environmental requirements with the aid of scenario procedures – Analysis and evaluation of technologies from environmental perspective – Environmental innovations and trends in automotive engineering
Teaching and Learning Methods:	Lectures, Exercises, Oral presentation by students
Assessment Method:	1. Report (70 %) 2. Individual presentation (30 %)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (3 SWS)
Self-study:	79 h
Recommended Prerequisites:	No specific requirements
Recommended Reading:	– *Adomßent, M.; Michelsen, G.* (2011): Transdisziplinäre Nachhaltigkeitswissenschaften. In: Heinrichs, H.; Kühn, K.; Newig, J (Hrg.): Nachhaltige Gesellschaft. VS Verlag für Sozialwissenschaften, S. 98-116. – Heinrichs, H.; Michelsen, G. (2014): Nachhaltigkeitswissenschaften. Springer Spektrum. – Grober, U. (2013): Die Entdeckung der Nachhaltigkeit, Kulturgeschichte eines Begriffs, Verlag Antje Kunstmann GmbH, München. – Pufé, I. (2017): Nachhaltigkeit, UTB GmbH; 3. überarb. Aufl. Edition. – Von Hauff, M. (2021): Nachhaltige Entwicklung – Grundlagen und Umsetzung. 3. aktualisierte Auflage. Oldenbourg Wissenschaftsverlag GmbH. München. Further literature will be recommended relating to the individual subjects.

Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	05.03.2024

7.23 Engineering Ethics

Module Code:	EE
Module Title:	Engineering Ethics
Type of Module:	
ECTS Credits:	4
Language:	German
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr. rer. nat. Margot Ruschitzka
Lecturers:	Dr. Hubertus Zilkens
Learning Outcome:	Students are able to (WHAT) ▪ gain knowledge and deep understanding of different ethical value systems including main features by (WITH) ▪ by discursively disputing their historical development and the impact on social and technical progress and synthesis of the social- and individually ethical perspective assessing the very own personality in order to (FOR) ▪ evaluate consequences of social- and technical decisions being expanded by a humanistic complement as well as the transfer of ethical transposition, for instance concerning profession-oriented leadership.
Module Content:	▪ Definition of the Terms Technology, Economy and Ethics – transdependency of the different disciplines ▪ History of the European sense of technological progress (we may as we can vs. we can what we may) ▪ Transfer of the classical cardinal virtues and vices to the industrial and business routines ▪ Ethics, social behavior and corporate social responsibility – the model of the Honorable Businessman ▪ Ethics and eligibility diagnostics (which ethical dispositions and cultural attributes should I earn to successfully obtain leading positions in a company)
Teaching and Learning Methods:	Lecture, interactive discussions and short presentations from the students
Assessment Method:	1. Written examination (120 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h
Recommended Prerequisites:	-
Recommended Reading:	▪ *Bowen, W.* (2014): Engineering Ethics - Challenges and Opportunities. Springer ▪ *van de Poel, I.; Royakkers, L*. (2011): Ethics, Technology, and Engineering: An Introduction. Further reading to be given during lectures.

Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.24 Automotive Supply Chain Management

Module Code:	ASCM
Module Title:	Automotive Supply Chain Management
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: English ▪ Teaching Material: English
Duration of Module:	1 Semester
Recommended for Semester:	1
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr. rer. pol. Helmut Schulte Herbrüggen
Lecturers:	Prof. Dr. rer. pol. Helmut Schulte Herbrüggen
Learning Outcome:	Students are able to (WHAT) ▪ creatively develop and design optimized international Automotive Supply Chain solutions by (WITH) ▪ applying supply chain analysis, concept design and best practice measures using a combination of methods like benchmarking, Just-in-Time, Just-In-Sequence, Total Quality Management and Total Productive Maintenance in order to (FOR) ▪ carefully focus on customer requirements and simultaneously on company efficiency with respect to cost, quality and time as well as meeting ecological, social, ethical and other important goals appreciated by societies worldwide.
Module Content:	▪ Basics and definitions of Automotive Supply Chain Management Systems ▪ Goals and Strategies of Automotive Supply Chain Management Systems ▪ SCOR (Supply Chain Operations Reference) – Model ▪ Analysis and Design focussing on LEAN Automotive Supply Chains through prevention of waste, minimization and optimization of interfaces, standardization and modularization, integrated quality assurance, transparency and visualization concepts, motivation concepts, internationalization, network design, partnering, sustainability and continuous improvement / Kaizen) ▪ Supply Chain Collaboration in order to reduce bullwhip effects and support logistical integration of Automotive Supply Chain resources ▪ Controlling of Automotive Supply Chain Systems ▪ Automotive Supply Chain Event and Risk Management ▪ Innovative and integrative concepts for Automotive Supply Chain Management Systems
Teaching and Learning Methods:	▪ Lectures ▪ Exercises
Assessment Method:	1. Written examination (90 min) *dictionary without any comments allowed: English-English, English-German and German-English*
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	41 h (3 SWS)
Self-study:	79h

Recommended Prerequisites:	Basic knowledge of Logistics and Supply Chain Management is recommended.
Recommended Reading:	▪ Harrison, A. et. al. (latest edition): Logistics Management & Strategy – Competing Through the Supply Chain, Harlow: Pearson Education (currently: 6. ed. 2019) ▪ Russell, R.S./ Taylor, R.W. (latest edition): Operations and Supply Chain Management, International Student Version, John Wiley & Sons Singapore Pte. Ltd. (currently: 8. ed. 2014) ▪ Mangan, J./ Lalwani, C. (latest edition): Global Logistics and Supply Chain Management, Chichester: John Wiley & Sons Ltd. (3. ed. 2016) ▪ Coyle, John J. et al. (latest edition): Managing Supply Chains: A Logistics Perspective, Canada: South Western, Cengage Learning (currently: 10. International ed. 2016) Further course related literature (books, journals or articles) may be indicated during the course.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	13.11.2020

7.25 Component Design, Materials and Manufacture

Module Code:	CDMM
Module Title:	Component Design, Materials and Manufacture
Type of Module:	
ECTS Credits:	4
Language:	▪ English/German lecture notes and slides ▪ English/German language
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Peter Krug
Lecturers:	Prof. Dr.-Ing. Peter Krug
Learning Outcome:	Students are able to (WHAT) ▪ transfer requirements to adequate component design, ▪ apply their knowledge about materials and manufacturing to derive manufacturing strategies from component design and requirements in service, ▪ prepare a precise production plan by combining materials treatment and manufacturing, methods and formulate a bill of material, ▪ analyze critical production steps and evolve back up strategies, conduct the scheduled manufacturing process, ▪ control the manufacturing process with regard to the required quality and design/process changes and formulate ▪ apply appropriate quality checks to assure operational reliability of manufactured components, by (WITH) ▪ periodic critical assesment the manufactured part and manufacturing process (including planning ▪ analyzing, and comparing achieved results with real parts and processes (component based or literature based), in order to (FOR) ▪ summarize the whole process, identify consistencies and inconsistencies, advantages and disadvantages, redesign the whole production plan based on their experience derived during the project ▪ finally pursue the principle development processes of components in automotive industry.
Module Content:	Tracing the manufacturing process of typical automotive components starting with definition of requirements and constraints, designing the component, manipulating materials´ properties during the manufacturing process, quality control. The project results will be documented in a written report and presented by the students within the frame of the Scientific and Interdisciplinary Seminar (Scientific Engineering Project)
Teaching and Learning Methods:	Project based learning with lectures, laboratory work, oral presentation by students
Assessment Method:	1. Groupwise oral presentation of group project with colloquium (45 min)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h

Recommended Prerequisites:	Materials science, mathematics, mechanical design, requirements and boundary conditions of automotive components in service
Recommended Reading:	▪ *J. Lesko; Industrial Design:* Materials and Manufacturing Guide ▪ *Miltiadis A. Boboulos:* Manufacturing Processes and Materials: Exercises ▪ *R. Creese:* Introduction to Manufacturing Processes and Materials ▪ *M. P. Groover;* Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	21.03.2021

7.26 Virtual Reality

Module Code:	VR
Module Title:	Virtual Reality
Type of Module:	
ECTS Credits:	4
Language:	Teaching: German Teaching materials, documentations, software: German/(English)
Duration of Module:	1 semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Christoph Ruschitzka
Lecturers:	Prof. Dr.-Ing. Christoph Ruschitzka
Learning Outcome:	The students are able to (WHAT) ▪ project virtual environments, ▪ design virtual engineering sessions and visualization studies, ▪ coordinate collaborative VR-sessions, ▪ decide between different hard- and software-VR-solutions by (WITH) ▪ using different VR-simulation software toolkits in oder to (FOR) ▪ design and implement VR-simulations for applications in the automotive industry.
Module Content:	Lessons ▪ Terms and definitions, history of virtual reality ▪ VR-Input-devices (dots of freedom, tracking methods, finger-tracking, eye-tracking, optical & mechanical devices) ▪ VR-Output-devices (stereoscopy, visualization hardware (Desktop-VR, HMDs, Holo-Bench, Powerwall, CAVE), haptic devices) ▪ Realtime aspects (latency, collision detection, rendering methods) ▪ Virtual worlds (Human-Computer-Interaction, selection, navigation and manipulation) ▪ Industrial software solutions (engineering software tools, visualization tools, development tools, vr-frameworks) VR-Project The project results will be documented in a written report and presented by the students within the frame of the Scientific and Interdisciplinary Seminar (Scientific Engineering Project).

Teaching and Learning Methods:	Lectures and practical exercises using different VR-Systems Project
Assessment Method:	Report with presentation
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	28h (2 SWS)
Self-study:	92h
Recommended Prerequisites:	Previous knowledge of various CAD-&CAE-Tools (CATIA, HyperWorks, INSPIRE…) and experiences in programming software tools are helpful.
Recommended Reading:	*Dörner, Broll, Grimm, Jung:* Virtual und Augmented Reality (VR/AR) – Grundlagen und Methoden der virtuellen und augmentierten Realität, Springer Verlag Berlin Heidelberg, 2. Auflage 2019 *M. Claudia tom Dieck, Timithy Jung:* Augmented Reality and Virtual Reality - The Power of AR and VR for Business, Springer-Verlag 2019 Armin Grasnick: Grundlagen der Virtuellen Realität, Springer Verlag Berlin Heidelberg 2020 *Brill:* Virtuelle Realität (Informatik im Fokus), Springer Verlag Berlin Heidelberg, 2009
Use of the Module in Other Degree Programs:	
Particularities:	
Last update:	09.09.2022

7.27 Cost-Efficient Product Design

Module Code:	CEPD
Module Title:	Cost-Efficient Product Design
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German, English on request ▪ Teaching material: German, English on request
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Alexander Stekolschik
Lecturers:	Prof. Dr.-Ing. Alexander Stekolschik
Learning Outcome:	The students are able to (WHAT) ▪ identify and solve a variety of issues and problems related to product costs and product development processes in the automotive industry and production by (WITH) ▪ identifying and optimizing product costs and cost drivers ▪ identifying requirements on cost-efficient products ▪ applying methods of target costing to new products ▪ analyzing product properties influencing costs ▪ relating different product related factors to manufacturing costs ▪ defining product structure and product variants ▪ analyzing and breaking down product life cycle costs in order to (FOR) ▪ develop competitive products and ▪ optimize automotive product development processes
Module Content:	Projects to different topics regarding cost-efficient product design, examples: ▪ Product Lifecycle, Product types ▪ Cost management for Product Development ▪ Target cost oriented Product Development, cost drivers ▪ Influencing product life cycle costs ▪ Factors and procedures for Lean Product Design ▪ Product variant management ▪ Influence of tools in Product Development ▪ Time to market ▪ The project results will be documented in a written report and presented by the students within the frame of the Scientific and Interdisciplinary Seminar (Team based Engineering Project).
Teaching and Learning Methods:	▪ Workshops ▪ Project work ▪ Presentations and written reports
Assessment Method:	1. Project report with project presentation
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	55 h (4 SWS)
Self-study:	65 h

Recommended Prerequisites:	Basic knowledge in Engineering Product Design / Product Development
Recommended Reading:	▪ *Hundal, M.; Ehrlenspiel, K.; Kiewert, A.; Lindemann, U.*: Cost-Efficient Design ▪ *Ehrlenspiel, K.; Meerkamm, H.*: Integrierte Produktentwicklung: Denkabläufe, Methodeneinsatz, Zusammenarbeit, München: Carl Hanser Verlag, 2013 ▪ *VDI 2221 Blatt 1:2019-11*: Entwicklung technischer Produkte und Systeme; Modell der Produktentwicklung (Design of technical products and systems; Model of product design). Berlin: Beuth Verlag
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.28 Driver Assistance Systems

Module Code:	DAS
Module Title:	Driver Assistance Systems
Type of Module:	
ECTS Credits:	4
Language:	▪ Teaching: German, English ▪ Teaching material: German, English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Tom Tiltmann
Lecturers:	Prof. Dr.-Ing. Tom Tiltmann
Learning Outcome:	The students are able to (WHAT) ▪ understand classes, types and operation modes of essential driver assistance systems, ▪ identify technical requirements concerning implementation of driver assistance in modern vehicles, by (WITH) ▪ using sensors, actors, Microcontrollers and Single Board Computers running the Robot Operating System framework in order to (FOR) ▪ create a functional prototype of a DAS
Module Content:	▪ Classification and different types of DAS ▪ Technical requirements for DAS ▪ Testing methods and evaluation of DAS ▪ Basics of the Robot Operating System (ROS) ▪ Implementation of DAS on a RC model using ROS ▪ Team based engineering project in the field of sensors and collision avoidance
Teaching and Learning Methods:	▪ Fundamental workshops (groups of 2-3) ▪ Team based engineering project (groups of 2-3) ▪ Oral presentation (15 min.), practical presentation (10 min.) and written report (10 – 15 p.)
Assessment Method:	1. Project report (75%) 2. Project presentation (25%)
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	34 h (2,5 SWS)
Self-study:	86 h
Recommended Prerequisites:	Knowledge about vehicle concepts and integration Basic understanding of programming languages (preferably C++/python) First experiences with linux Fundamental knowledge of electrical engineering
Recommended Reading:	▪ *Morgan Quigley, Brian Gerkey, William D. Smart*: Programming Robots with ROS: A Practical Introduction to the Robot Operating System ▪ *Kramer, F.:* Integrale Sicherheit von Kraftfahrzeugen. Springer, 2013.

	▪ *Winner, H.; Hakuli, S.; Wolf, G.:* Handbuch Fahrerassistenzsysteme. Vieweg-Teubner, 2012.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	

7.29 Mobility Concepts

Module Code:	MC
Module Title:	Mobility Concepts
Type of Module:	
ECTS Credits:	4
Language:	▪ German ▪ Teaching material and some exercise: English
Duration of Module:	1 Semester
Recommended for Semester:	2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Michael Frantzen
Lecturers:	Prof. Dr.-Ing. Michael Frantzen
Learning Outcome:	The students are able to (WHAT) ▪ justify, defend, advertise and champion their ideas of new mobility concepts for future demands and continued improvements of sustainable mobility solutions for a changing world and society by (WITH) ▪ by developing advanced, sustainable mobility concept for a changing world and society and comparing existing models to their new proposed concepts in terms of the proposed usage, day-by-day usability, sustainability and expected costs in order to (FOR) ▪ this the students are capable of identifying basic ways of thinking in different disciplines and can develop their interdisciplinary ideas, even in the context of complex tasks. They are able to identify other´s and new working methods, define interface requirements and communicate transparently. The students can relate between different approaches, consider the meaning of internal and external influences and effects of other disciplines on mobility concepts.
Module Content:	▪ Introduction to mobility challenges ▪ Existing mobility concepts ▪ Special innovative vehicles and vehicle concepts for new models of traffic ▪ Future mobility
Teaching and Learning Methods:	▪ Lectures with problem based integrated exercises ▪ Presentations from industry and academic partners ▪ Project work in small teams, homework ▪ Practical seminar work in a simulated project environment with the help of innovation-, research- and project management-tools, in line with team work and individual tasks. ▪ Simulation of development systems and processes ▪ Practical work, (excursions) and presentations (incl. e.g. “elevator pitch”)
Assessment Method:	1. Project presentation and documentation of project 2. Project presentation and documentation of project
Workload (25 - 30 h ≙ 1 ECTS credit):	120h
Contact hours:	28 h (2 SWS)
Self-study:	92 h
Recommended Prerequisites:	High interest in interdisciplinary project work

Recommended Reading:	▪ Flügge et al. (2020): Smart Mobility Trends - Konzepte, Best Practices für die intelligente Mobilität. Springer Wiesbaden, 2. Auflage. ▪ Groth (2019): Von der automobilen zur multimodalen Gesellschaft? - Multioptionalität als Voraussetzung für multimodales Verhalten.Transcript Bielefeld. Further literature will be announced according to the selected subject.
Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	20.09.2022

7.30 Scientific Seminar / Advanced Technical English

Module Code:	ScSe / ATE
Module Title:	Scientific Seminar / Advanced Technical English
Type of Module:	
ECTS Credits:	No dedicated credits
Language:	▪ Teaching: English ▪ Teaching material: English
Duration of Module:	1 Semester
Recommended for Semester:	1 & 2
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Michael Frantzen ,
Lecturers:	Lecturers of faculty (technical supervison) & N.N. (supervision of English)
Learning Outcome:	Students are able to (WHAT) ▪ The students analyze and evaluate English written scientific papers and theses with scientific-technical content by (WITH) ▪ preparing sophisticated scientific reports and presentations in English while being supported by native-speaker in order to (FOR) ▪ present, exchange and discuss cross-modular scientific working results with (inter-) disciplinary scientific communities in English.
Module Content:	In this module students will work on a vehicle or mobility related subject with scientific background, provided by a lecturer of the faculty according to their choice. To assist students in improving their skills in technical English, the work is additionally supervised by native English speakers. The project results will be documented in a written report and presented by the students within the frame of the Scientific and Interdisciplinary Seminar (Scientific Engineering Project).
Teaching and Learning Methods:	Guided independent study
Assessment Method:	1. Presentations and documentation and discussion of cross-modular topics
Workload (25 - 30 h ≙ 1 ECTS credit):	
Contact hours:	
Self-study:	
Recommended Prerequisites:	Fundamental knowledge according to the selected technical subject and fundamental knowledge in management methods
Recommended Reading:	▪ *Hofmann, A.* (2004): Scientific Writing and Communication. Oxford University Press; 2nd Edition. ▪ *Skern, T.* (2019): Writing Scientific English: A Workbook. UTB GmbH; 3rd Edition. Further reading according to the selected subject.

Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	28.10.2020

7.31 Master Thesis

Module Code:	
Module Title:	Master Thesis
Type of Module:	
ECTS Credits:	30
Language:	English or German written text (English is recommended)
Duration of Module:	1 Semester
Recommended for Semester:	3
Frequency:	1 p.a.
Person Responsible for this Module:	Prof. Dr.-Ing. Toni Viscido
Lecturers:	All lecturers of faculty
Learning Outcome:	The students are able to (WHAT) ▪ apply the acquired theoretical knowledge, ▪ research and attain further theoretical knowledge that is necessary for the solution of the given problem, ▪ apply scientific methodology to the given task, ▪ use an interdisciplinary approach to a problem, ▪ plan and execute a longer-term project, by (WITH) ▪ independently working on a topic from the students subject area within a given period of time, both in its subject-specific details and in the interdisciplinary contexts, according to scientific and subject-specific practical methods in order to (FOR) ▪ document the results of independent professional work in a target and addressee-oriented manner.
Module Content:	The master thesis is an independently carried out engineering project from the area of the chosen profile within the MSc Automotive Engineering. It includes a written documentation of the results as well as the scientific methods that were applied during the work. It concludes with a verbal presentation and discussion of the project in the colloquium.
Teaching and Learning Methods:	Independent work by the student, supervised by the lecturer
Assessment Method:	1. Written documentation of the work with oral examination in a colloquium
Workload (25 - 30 h ≙ 1 ECTS credit):	900h
Contact hours:	
Self-study:	
Recommended Prerequisites:	Passed all six-credits-modules and one four-credit-module from the cluster “Scientific and Interdisciplinary Seminars” plus proven English skills.
Recommended Reading:	▪ *Hofmann, A.* (2004): Scientific Writing and Communication. Oxford University Press; 2nd Edition. ▪ *Skern, T.* (2019): Writing Scientific English: A Workbook. UTB GmbH; 3rd Edition. Further literature will be recommended relating to the according subject.

Use of the Module in Other Degree Programs:	
Particularities:	-
Last update:	20.09.2022

8 Appendix – Teaching Language and Language of Examination

Module Title	Language of Instruction	Teaching Material	Language of Examination
Adv. Body Engineering and Lightweight Design	English	English / German	German
Vehicle Concepts and Integration	German	some exercises in English	German / English on request
Vehicle Dynamics and Automotive Chassis	German (summary in English)	German / English	German / English on request
Vehicle Electronics and Communication	German / English	German / English	English
Adv. Combustion Engines	German	English	German / English on request
FEA in Body Engineering	German	German / English	German
NVH Systems Engineering	German / English	German / English (Software in English)	German / English on request
Adv. Vehicle Safety	German	German / English	German
Numerical Methods	German	German / English	German / English on request
Adv. Materials - Selection and Life Cycle Assessment	German / English	German / English lecture notes and slides	German / English on request
Adv. Thermodynamics	German	German / English	German / English on request
Simulation-based Production Controlling	German	German / English	German
Optimal Control and Estimation	German	lecture notes in German, programming examples in English	German
Statistical Optimization	German	German / English	German
Structural Durability	German/English	German / English lecture notes and slides	German
Vehicle Dynamics Simulation	German (summary in English)	German / English	German / English on request
Innovation Management	German / English on request	German / English on request	German / English on request
Automotive Manufacturing Processes	German / English	English	German / English on request
Corporate Management	German	English	German / English on request
Digital Factory	German / English on request	English	German / English on request
Legal Requirements and Homologation	German	German	German
Sustainability	German	German / English	German
Engineering Ethics	German	German	German
Automotive Supply Chain Management	English	English	English
Component Design, Materials and Manufacture	German / English	German / English lecture notes and slides	English
Virtual Reality	German	teaching materials, documentations and software in German / English	German
Cost-Efficient Product Design	German, English on request	German or English on request	German / English on request
Driver Assistance Systems	German / English	German / English	German / English on request
Mobility Concepts	German	some exercises in English	German / English on request
Scientific Seminar (übergeordnet)	English	English	German / English on request
Thesis			German / English on request

Imprint:

TH Köln
Gustav-Heinemann-Ufer 54
50968 Köln

www.th-koeln.de