Fachhochschule Köln
Cologne University of Applied Sciences

Fakultät für Fahrzeugsysteme und Produktion

Modulhandbuch für den Studiengang Master of Science Automotive Engineering mit den Profilen R & D und Production

Stand: 1. Oktober 2007

Content

Study Objectives

The master programme Automotive Engineering with the profiles R & D and Production prepares its graduates for management positions in the areas of research and development or process and production management within the automotive industry.

The students deepen their theoretical knowledge in the mathematical and engineering fundamentals and automotive applications on a high scientific level. In addition they will attain background knowledge and interdisciplinary expertise so that they can analyse, steer and improve the complex engineering processes of the automotive industry. The graduates will acquire the interface competence that qualifies them to accompany the complete value chain from conception through development and production to sales and service.

The students will be enabled to both lead project teams and be an effective team member themselves. They will have learnt to have an effective and goal-oriented approach to problems and to work independently even on new subject matters with demanding challenges in the areas of vehicle development and/or production technology and supply chain management.

In addition, the master degree lays the foundation for further scientific qualification in the form of doctoral studies (Promotion). It also qualifies the graduates for employment in the German public sector on the level of “höherer Dienst”.

Curriculum

	Credits	Credits	Credits
	30	**32**	**28**
Fundamentals	**6**	**6**	
Numerical Methods in Eng. Sciences	6		
Adv. Material and Manufacturing Technologies		6	
Automotive Systems	**12**	**4**	
Vehicle Dynamics & Automotive Chassis	4		
Advanced Combustion Engines	4		
Electronic Vehicle Systems	4		
Advanced Body Engineering		4	
Automotive Processes	**8**	**4**	
Automotive Supply Chain Management	4		
Production Management	4		
Automotive Management		4	
Elective I - General (1 of 3)	**4**		
Scientific Seminar			
Law (law of contract, EU-right, environmental law)			
Leadership			
Elective II - Engineering (3 of 14)	**12**		
Profile R & D: Applied Statistics in Planning and Control			
Profile R & D: CAx Fundamentals			
Profile R & D: NVH Systems Engineering			
Profile R & D: Advanced Thermodynamics			
Profile R & D: Structural Durability - Polymers - Component Failure			
Profile R & D: New Fuels and Automotive Technologies			
Profile R & D: Dev. of a Mechatronic System for Autom. Applications			
Profile Processes: Technology of Material Flow and Robotics			
Profile Processes: Manufacturing Methods and Process Chains			
Profile Processes: Technical Product Innovation			
Profile Processes: Automotive E-Business			
Profile Processes: Advanced Quality Management			
Profile Processes: Automotive Marketing and CRM			
Profile Processes: Strategic Automotive Management			
Elective III - Project	**6**		
** Product Development*			
** CA Simulation*			
** Troubleshooting*			
** Testing*			
** Maintenance*			
** Manufacturing*			
Master Thesis			**28**
Thesis			26
Colloquium			2

module name	Numerical Methods in Engineering Sciences

credits	6
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr. rer. nat. G. Engelmann
responsible	Prof. Dr. rer. nat. G. Engelmann

content	Principles and methods of the main fields of scientific computing: e.g. solution of linear systems, eigenvalue problems, singular value decomposition, solution of nonlinear equations, interpolation, numerical integration, solution of initial value problems
learning outcome	The students • are familiar with the main numerical methods used in engineering sciences, • are able to enjudge the performance and limitations of these methods, • are able to choose and apply these methods correctly, • are able to write Matlab® programs to perform numerical tasks in engineering sciences, • know the algorithms for the main numerical methods implemented in Matlab®.
teaching methods	• seminaristic lectures with self studies • excercises and pracitcal training
practical laboratory work	
language	teaching: german teaching material: english
examination	written examination (120 min)
prerequisites	Knowledge in linear algebra and analysis programming skills in Matlab®
recommended literature	*Moler, C.: Numerical Computation, SIAM, Philadlphia, 2004* *(download: www.mathworks.de/academia/faculty center, for introduction)* *Quarteroni, A.; Sacco, R.; Salieri, F.: Numerical Mathematics, Springer, New York, 2000* *Trefethen, L.N.; Bau III, D.: Numerical Linear Algebra, SIAM, Philadelphia, 1997* *Ascher, U.M.; Petzold, L.R.: Computer methods of ordinary differential equations and differential-algebraic equations, SIAM, Philadelphia, 1998*

workload (h)		
	Teaching lessons (5 SWS)	*80 h*
	Self studies:	*70 h*
	(including preparation for the exercises and practical training)	
	Preparation for examination:	*30 h*
	In total:	***180 h***

module name	Advanced Material and Manufacturing Technologies

credits	6
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. C. Hartl, Prof. Dr.-Ing. M. Matoni, Prof. Dr.-Ing. K. Segtrop, Prof. Dr. rer. nat. J. Stollenwerk
responsible	Prof. Dr.-Ing. C. Hartl, Prof. Dr.-Ing. M. Matoni, Prof. Dr.-Ing. K. Segtrop, Prof. Dr. rer. nat. J. Stollenwerk

content	Advanced materials and manufacturing technologies with emphasis on automotive applications: Physical basics, material science (high strength, light metals, sinter metals, polymers, ceramics), thin coatings, production processes for cast parts, forming technologies, machining processes, joining technologies, process steps, network of the process, process analysis, planning, controlling, process optimisation
learning outcome	The students • understand the physical, material and manufacturing aspects of modern materials, • know aspects of recycling and light weight materials, • know different coating technologies to improve material properties, • are familiar with modern production and machining processes, • know the function of analysis, planning, controlling and optimisation of processes.
teaching methods	• lectures • excercises • laboratory work, project work • discussion (individual)
practical laboratory work	Fracture toughness on metals, preparation of thin films, forming of leightweight materials
language	English lecture notes and slides, German language
examination	Written examination (120 min)
prerequisites	Basics in material science and manufacturing technologies
recommended literature	*Tipler: Physics for scientists and engineers, Worth Publisher, Inc., New York, 1991* *Maissel, G.: Handbook of thin film technologie, McGraw-Hill. Inc., 1983* *Askeland, D.R.; Phule, P.P.: The science of engineering materials* *Callister, W.D.Jr.: Materials Science and Engineering- an Introduction* *Mikell, P., G.: Fundamentals of modern manufacturing: Materials, Processes and Systems, 3rd edition, publisher: Wiley, 2006*

workload (h)			*L*	*E*	*Project*	*Practical*
	Teaching lessons (5 SWS)	*89 h*	*42 h*	*16*	*25 h*	*6 h*
	pre- and afterwork:	*46*	*8 h*	*16 h*	*10 h*	*12 h*
	Preparation for examination:	*45 h*				
	In total:	***180 h***				

module name	Vehicle Dynamics and Automotive Chassis

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr.-Ing. J. Betzler
responsible	Prof. Dr.-Ing. J. Betzler

content	Description of the handling behaviour in detail procedures, identifying the demands of longitudinal, lateral and vertical dynamics, tuning suspension systems to fulfil dynamics requirements
learning outcome	The students • will be able to describe the handling behaviour of vehicles, • will know the basics of steering system requirements, • will have more than average knowledge in the field of suspension technology, • will have more than average knowledge how to tune suspension systems.
teaching methods	• lecture with excercises • practical training in very small groups (6 students)
practical laboratory work	Using a k&c rigg to measure the kinematic properties of suspension systems and doing an analysis of its behaviour
language	teaching: german (summary: english) teaching material: english
examination	written examination (90 min)
prerequisites	Vehicle dynamics, basics of automotive chassis, practical mathematics
recommended literature	*Robert Bosch GmbH: Automotive Handbook, Düsseldorf, VDI Verlag, 1991* *Mikkiken, W. and D.: Race Car Vehicle Dynamics, Warrendale, USA, SAE, 1995* *Reimpell, J.; Stoll, H.; Betzler, J.: The Automotive Chassis: Engineering Pronciples, Lodon, Butterworth and Heinemann, 2000* *Reimpell, J.; Betzler, J.: Podwozzia samochódow Podstawy konstrukcji, Warszawa, Wydawnictwa, Komunikacjy i Laczno´sci sp. Z o o, 2001*

workload (h)			*L*	*E*	*P*
	Teaching lessons (3 SWS)	*48 h*	*16 h*	*16 h*	*16 h*
	pre- and afterwork:	*16 h*	*16 h*		
	Test report:	*36 h*			*36 h*
	Preparation for examination:	*20 h*			
	In total:	***120 h***			

module name	Advanced Combustion Engines

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr.-Ing. W. Jordan
responsible	Prof. Dr.-Ing. W. Jordan

content	Supercharging of engines (turbocharging, resonance charging, variable length intake manifolds, compressors), exhaust emissions and emission control systems, forces inside the engine, mass balancing, engine torque, torque fluctuations, rotational vibrations
learning outcome	The students • know the several systems of supercharging in function and basic knowledge, • understand the coherences and technology of the piston engine including the theoretical background, • know the reasons of gas- and mass forces of the engine, • know the methods of mass balancing, • will be able to design a mass balancing, • know the reasons for torque fluctuations and its influence to the power train.
teaching methods	• lecture • excercises • presentation • practical training on engines small groups
practical laboratory work	Measurement of in-cylinder pressure versus crank-angle and calculation of torque and engine speed fluctuations
language	teaching: german teaching material: english
examination	written examination (120 min)
prerequisites	Physics, chemistry, thermodynamics, mathematics, statics, dynamics, material science, electrical engineering, vehicle driving mechanics
recommended literature	*Internal Combustion Engine Handbook, SAE* *Robert Bosch GmbH: Automotive Handbook, Düsseldorf, VDI Verlag, 1991* *SAE technical Papers for up-to-date publications*

workload (h)			*L/E*	*P*
	Teaching lessons (3 SWS)	*54 h*	*48 h*	*6 h*
	pre- and afterwork:	*46 h*	*36 h*	*10 h*
	Preparation for examination:	*20 h*		
	In total:	***120 h***		

module name	Advanced Body Engineering

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. F. Herrmann
responsible	Prof. Dr.-Ing. F. Herrmann

content	Advanced materials and production methods for vehicle structures, tools in car body and vehicle structure development (FEM, CAD free form surface modelling)
learning outcome	The students • are able to carry out concept designs of vehicle bodies and structures components, • know about the computational simulation and design techniques, • know how to develop a concept beginning from a blank sheet up to a first dimensioning of the component, • can apply acquainted specific knowledge of advanced body materials and production methods on the development process of car body and vehicle structure.
teaching methods	• lectures with integrated excercises • seminaristic lectures • practical training
practical laboratory work	
language	teaching: german teaching material: english
examination	written examination (90 min)
prerequisites	Body Engineering basics or adequate knowledge in body engineering
recommended literature	*Activa car Design - Mobility and Technologies, 2005* *Timothy, R.: Advanced Sheet Metal Fabrication, 2003* *Automotive Circle International: Aluminium-Steel-Hybrid Structures, 2003* *An actual list of literature will be given in the lectures.*

workload (h)		
	Pre-module preparation:	*4 h*
	Teaching lessons (3 SWS)	*48 h*
	pre- and afterwork:	*32 h*
	Preparation for examination:	*36 h*
	In total:	***120 h***

module name	Electronic Vehicle Systems

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr.-Ing. U. Langer
responsible	Prof. Dr.-Ing. U. Langer

content	Electrical Problems in vehicles, Appreciation of the peculiarities of automotive data technology, knowledge of new and future areas of development content, (X-by-wire systems, controller, CAN-bus-systems, advanced bus-systems), EMV/EMS, boardnet supply, hybrid drive systems, new fuels and drives
learning outcome	The students • Should have an overview on automotive electronical control systems with respect to state of the art, future tendencies and limits and failures behaviour of all electronical components
teaching methods	• lectures • seminars • excursions
practical laboratory work	Lights, electrical power control, different power generators, CAN-bus-functionality, Bus failur behaviour, controler/memory behaviour
language	teaching: german
examination	written examination (30 min) (30 %) seminar work presentation (30 %) seminarwork (60 min homework), project (40 %)
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 literature	*ATZ, Springer Verlag* *ATZ-electronics, Springer Verlag* *MTZ, Springer Verlag* *EU-IP on "new fuels and drive systems in vehicles" (see homepage KDG.be or pwr.wroc.pl, FH Joaenneum, A)* *New electronics (available at the Lehrgebiet FMU or Ulrich.langer@fh-koeln.de)* *Internet* *FIZ-technik (international technical data base), available in every recommended library)* *VDI-Fortschrittsberichte* *Haus der Technik, Essen* *Recherche in der Datenbank des BMBW*

workload (h)			*L*	*E*	*P*
	Teaching lessons (3 SWS)	*59 h*	*32 h*	*21 h*	*6 h*
	pre- and afterwork:	*28 h*			
	Preparation for examination:	*33 h*			
	In total:	***120 h***			

Module Name	Automotive Supply Chain Management

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr. rer. pol. H. Schulte Herbrüggen
responsible	Prof. Dr. rer. pol. H. Schulte Herbrüggen

Content	Basics and definitions of Supply Chain Management Systems • Goals of Supply Chain Management Systems • SCOR (Supply Chain Operations Reference) - Model • Planning and Design Concepts for Supply Chain Management Systems • (e.g. prevention of waste, minimization and optimization of interfaces, standardization and modularization, integrated quality assurance, transparency and visualization concepts, motivation concepts, internationalization aspects, network design, partnering, sustainability, continuous improvement / Kaizen) • Introduction Strategies for Supply Chain Management Systems • Supply Chain Benchmarking • Controlling of Supply Chain Management Systems • Advanced Concepts of Supply Chain Management Systems
learning outcome	The students learn to • understand the challenges of today's markets through individualization of customers' wishes as well as through globalization of demand and supply, • know how to meet the high expectations of shareholders and stakeholders by building up carefully balanced logistical automotive chain networks that provide customers with Just-In-Sequence solutions, • know how to carefully coordinate and integrate strategies, systems and skills of an enterprise as well as those of its partners in order to be able to flexibly respond to the requirements of the customers in different markets, • know how to use concepts of rationalization by eliminating waste (Lean Production Management) and assuring Total Quality Management (TQM) and Total Productive Maintenance (TPM), • professionally use instruments like early warning systems and benchmarking in order to meet customer expectations better than competitors and to realize best practices.
teaching methods	Interactive Lectures requiring considerable participation of the students, as they permanently have to answer questions leading them the way to achieving the learning goals. Lecture contents will be visualized by videos, giving supply chain examples from international production companies. Project Exercises give students an opportunity to be trained respectively. Students first have to formulate questions reflecting the contents of the lecture. This process is moderated by one of the students. The following discussion concerning the elaboration of a solution is conducted by another student. Eventually, the presentation of the results may be presented by yet another student, thus giving with each question up to three students the opportunity to demonstrate and subtilize their analytical and rhetorical skills as well as their body language. The whole process is being carefully monitored and supported by the instructor. Students' Presentations and Discussion require that the students have worked out reports a during the first few weeks of a semester. The written reports and presentations will comprise special topics of Automotive Supply Chain Management. The presentations will be in front of other students and the professor. Every presentation will be followed by a discussion on the findings.
language	Englisch
examination	Written report, presentation and verbal discussion on the findings documented (80%) . Active participation in discussions (20%)
prerequisites	Profound knowledge of industrial business administration, production planning and control systems as well as logistics is very helpful. Additionally knowledge in electronic technologies is also advisable as these technologies are experiencing a rapid evolution and diffusion.
recommended Literature	Coyle, J./ Bardi, E.J./ Langley, C.J.; The Management of Business Logistics: A Supply Chain Perspective, 7. Auflage, Mason (Ohio) 2003. Gaither, N./ Frazier, G.; Operations Management, Cincinatti (Ohio) 2002 Van Weele, V.; Purchasing and Supply Chain Management: Analysis, Strategy, Planning and Practice, 4 ed. London 2005 Wisner, J.D./ Leong, G.K./ Tan, K.-Ch.; Principles of Supply Chain Management: A Balanced Approach, Mason (Ohio) 2005

workload (h)			*Lecture/*	*Seminar*
	Course (3 SWS)		*48 h*	*48 h*
	Preparation and follow-up course work	*24 h*	*24 h*	
	Students' Report			*48 h*
	In total:	**120 h**		

modul name	Production Management (PRM)

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr.-Ing. H. Abels
responsible	Prof. Dr.-Ing. H. Abels

content	• Basics and definitions of Production Management, • Challenges and aims of Production management in the automotive production, • Organizational design of Production Management in the automotive production, • The Toyota Production Systems and Lean Manufacturing as a design frame for Production Management (Total Production System), • IT-solutions for Production Management
learning outcome,	The students • can explain the challenges, aims and success factors of Production Management. • know the typical structure and design elements of Production Systems. • can use important organizational design principles.
teaching methods	• Lessons • Training the methods in case studies (Work groups, business game) • Individual discussions • Blended Learning
Language	Englisch
examination	Written examination, 120 min
prerequisites	Profound knowledge of industrial business administration, production planning and control logistics Additional knowledge in IT-technologies is advisable.
recommended literature	Varenkamp, R. Produktionsmanagement 2004 Lebefromm, U. Produktionsmanagement 2003 Feggeler, A. u.a. Ganzheitliche Produktionssysteme 2003 Spath, D. Ganzheitlich produzieren 2003

workload (h)		*L*	*E*	*Business Game*	
	Course (4 SWS)	*64 h*	*32 h*	*16 h*	*16 h*
	Preparation and follow-up course work	*32 h*			
	Preparation for Examination :	*24 h*			
	In total:	**120 h**			

module name	Automotive Management

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	Prof. Dr. rer. pol. M. Schmieder
responsible	Prof. Dr. rer. pol. M. Schmieder

content	• Managementmethoden in der Automobilbranche • Unternehmensziele formulieren • Shareholder value versus stakeholder Maximierung • Unternehmenskultur • Fact based management • Benchmarking • Balanced Scorecard • Six Sigma • Personalmanagement • Mitarbeiter Zielvereinbarungen • 360° Feedback • Case Study Managementmethoden
learning outcome	The students • know different management principles and are able to apply the methods in business • have the knowledge about fact-based measurement methods and process optimization • have skills in leadership and management by motivation and are able to use these skills
teaching methods	• Lectures and seminars • Small groups • Individual discussions
language	Englisch
examination	Written examination 60 min.
prerequisites	Profound knowledge of basic management methods
recommended literature	Pfläging, Niels: Beyond Budgeting: Better Budgeting. Haufe, Freiburg 2004 Ebel, Bernhard; Hofer, Markus B.; Al-Sibai, Jumana: Automotive Management: Strategie und Marketing in der Automobilwirtschaft. Springer, Berlin 2003. Kurek, Rainer: Erfolgsstrategien für Automobilzulieferer: Wirksames Management in einem dynamischen Umfeld. Springer, Berlin 2004.

workload (h)		*L/E*	*P*	
	Course (3 SWS)	*48 h*	*48 h*	*-*
	Preparation and follow-up course work	*32 h*	*32 h*	*-*
	Preparation for Examination :	*40 h*		
	In total:	**120 h**		

module name	Law (law of contract , EU- right, environmental law)

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	N.N.
responsible	Prof. Dr. rer. pol. M. Schmieder

content	x Bases of the treaty right x Law of obligation x Act of sale/service agreement/contract x labour/contract for work and materials/ x Bases of the European Union right x Bases of the environment law
learning outcome	The students x Know the basics in contract law, law of obligation, EU-law and environmental law x know most of the regulatory framework concerning commercial operations in B2B/B2C and they know about their leagal responsibility
teaching methods	2 hours of lecture 2 hours of exercise
language	teaching: german material: englisch, german
examination	Written examination 60 min.
prerequisites	
recommended literature	Hoppe; Beckmann: Umweltrecht, Juristisches Kurzlehrbuch, München 1989 Kimminich; v.Lersner; Storm: Handwörterbuch des Umweltrechts, 2 Bände, 2. Auflage, Erich Schmidt Verlag: Berlin 1994 Storm: Umweltrecht: Einführung. 5. Auflage, Erich Schmidt Verlag: Berlin 1992 Arndt, H.-W.: Europarecht, 2. Aufl. Heidelberg 1995 Borchardt, K. D.: "Die rechtlichen Grundlagen der Europäischen Union", Stuttgart 1996 Fastenrath, U.; Müller-Gerbes, M.: Basiswissen Recht, Europarecht, Freiburg 1996 Herdegen, M.: Europarecht, München 1997 Zacker, C.: Kompendium Europarecht, Berlin/Heidelberg/New York 1997 Weitere Literatur wird in der Veranstaltung bekannt gegeben.

workload (h)		L/E	P	
	Course (3 SWS)	48 h	48 h	-
	Preparation and follow-up course work	32 h	32 h	-
	Preparation for Examination :	40 h		
	In total:	120 h		

module name	Leadership

credits	4
designated degree	Master of Science Automotive Engineering 1. Semester
lecturer	N.N.
responsible	Prof. Dr.-Ing. Ch. Hartl

content	Leadership and human resources, leadership and organization, communication and conflict, cross cultural cooperation, international management.
learning outcome	The course enables students to perform managerial functions in global organizations and enterprises, as well as to evaluate consequences of operational decisions.
teaching methods	x Lecture x Exercise x Case studies
examination	Oral examination (1 h)
prerequisites	None
recommended literature	Literature will be recommended relating to the subject currently dealt with.

workload (h)				
		L	E and C	case studies
	Course (3 SWS)		90 h	60 h	30 h
	Preparation and follow-up course work 30 h				
	In total:	120 h			

module name	Applied Statistics in Quality Planning and Control

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. S. Bracke
responsible	Prof. Dr.-Ing. S. Bracke

content	The students shall understand the Approaches and Strategies of Total Quality Management. Furthermore the Focus is the Application of technical Methods and Tools for effective Total Quality Management particularly those commonly used in the Automotive Industry.
learning outcome	The Students know x Fundamentals of Quality Planning and Test Planning x Phases and Activities of Product and Process Development x Elementary Methods of Quality Planning x Quality Function Deployment x Design of Experiments x Statistical Process Control The Students are able to x apply Statistics for Quality Planning and Test Planning (Focus: DoE, SPC) x evaluate the result of experimental designs x evaluate the important characteristics in production process
teaching methods	x Lecture, including Exercises and Workshop with Presentation realized by Students x Learning in small Groups x (Company Excursion) x Guest Lecturer
language	teaching: English material: english
examination	Written examination; 25% of the Result is influenced by the Presentation realized by Students
prerequisites	Fundamentals of Quality Management Fundamentals of Mathematics (Focus: Statistic) Fundamentals of Manufacturing Processes
recommended literature	Pyzdek: The Six SIGMA Handbook, Publisher: Mcgraw-Hill Professional; Edition: Rev Exp (2003) Pfeifer, Thilo: Quality Management. Strategies, Methods, Techniques, Publisher: Hanser Fachbuchverlag, Edition 2001 Geiger, Walter: Handbuch Qualität, Publisher: Vieweg-Verlag; Edition: 4., April 2005 Kamiske, Gerd F.: Qualitätsmanagement von A-Z, Hanser Verlag, Edition 5., 2005

workload (h)		L	E	P	
Course (4 SWS)		64 h	48 h	16 h	-
Preparation and follow-up course work	40 h	32 h	8 h	-	
Preparation for Examination :	16 h				
In total:	120 h				

module name	CAx Fundamentals

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing Ch. Ruschitzka
responsible	Prof. Dr.-Ing Ch. Ruschitzka

content	Virtual vehicle creation, e.g.: current engineering, vehicle design & creation processes and their components: e.g.: feature based design, parametric design, virtual reality, augmented reality, PDM/PLM-systems. Simulation in automotive engineering: FEM-Basics (Theories of elasticity, stiffness matrices, boundary conditions, equation solvers, criteria for the construction of FEM grids, optimisation); Simulation in the CAE process of vehicle design (e.g.: design of vehicle components (durability, nvh, ….), multi-body simulation, heat transfer, CFD, motion, NC-simulation, non-cutting shaping,…) Opportunities and limits of simulation.
learning outcome	The students • know how to construct FE grids and know how to lead assumptions, • know the requirements of material libraries and their application, • are able to do static and dynamic analyses, vibration analysis, simple crash simulation and flow simulations, • are able to optimize structures and geometries, • are able to use software toolkits for VR-Simulations
teaching methods	• lectures supervised practical exercises (3SWS) using CATIA, Fluent, Abaqus, IDO, COVISE and others
practical laboratory work	
language	teaching: german teaching materials: english software: english
examination	written examination (60 min) (50 %) tests on the systems (50 %) The successful participation in the training period is a prerequisite for the examination
prerequisites	Some previous knowledge of 3D CAD systems, especially CATIA, UNigraphics or Pro/Engineer Helpful: module CAD II of Bachelor Fahrzeugtechnik Useful: module Virtuelle Produktentwicklung of the Bachelor Fahrzeugtechnik
recommended literature	*Astley, R.: Finite Elements in solids and structures. Chapman & Hall* *Belytschko, a.o.: Nonlinear Finite Elements for continua abd structures, John Wiley&Sons* *Storakers: On the Material Representation and constitutive branching in Finite Compressible Elasticity, J.Mech.Phy.Solids* *An actual list of recommended literature will be placed at disposal online.*

workload (h)		*L*	*P*
Teaching lessons (4 SWS)	*64 h*	*16 h*	*48 h*
pre- and afterwork:	*32 h*		*32 h*
Preparation for examination:	*24 h*		
In total:	***120 h***		

module name	NVH Systems Engineering

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. K. Becker, Prof. Dr.-Ing. A. Faßbender
responsible	Prof. Dr.-Ing. K. Becker, Prof. Dr.-Ing. A. Faßbender

content	Advanced mechanical vibrations, advanced acoustics, advanced signal analysis, hydraulics, computer-based tools in NVH development
learning outcome	The students • can apply state-of-the-art process-oriented methodologies and tools in NVH development, • know the scientific basics of mechanical vibrations, acoustics, signal analysis and hydraulic components and systems, • know about the NVH peculiarities of computer-based tools like FEM, multibody, digital signal acquisition/analysis and hydraulic simulations • are capable to apply this know-how to automotive applications
teaching methods	• lecture with focus on NVH basics (75 % - mechanics, acoustics, signal analysis) and hydraulic in automotive systems (25 %) • case-study based project work with special focus e.g. on hydraulic applications or other state-of-the-art topics • use of e-learning system for distribution of course material and actual lecture notes
practical laboratory work	Project work
language	teaching: german teaching materials: english software: english
examination	- Project work with documentation (60 %) - presentation and colloquium (40 %)
prerequisites	Knowledge in "Fahrzeugschwingungen und - akustik" sowie "Grundlagenkenntnisse Hydraulik" (see Bachelor Fahrzeugtechnik) as recommendation
recommended literature	*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*

workload (h)		*L/E*	*Project*
	Teaching lessons (3 SWS)	*32 h*	*32 h*
	pre- and afterwork:	*88 h*	*88 h*
	In total:	***120 h***	

module name	Advanced Thermodynamics

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. K.-U. Münch
responsible	Prof. Dr.-Ing. K.-U. Münch

content	Unsteady heat transfer, analogy between mass- and 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
learning outcome	The students • know about combustion technology and humid air and air conditioning, • know the heat transfer, • know the unsteady heat transfer phenomena, • will be able to apply the analogy between heat- and mass transfer
teaching methods	• lectures • exercise courses • laboratory courses
practical laboratory work	Tests on engine and ignition test rigs
language	teaching: german teaching materials: english
examination	written examination (120 min)
prerequisites	Higher Mathematics, basic lectures thermodynamics and fluid dynamics
recommended literature	*Kuo, K.K.: Principles of combustion, Wighly & Sons, New York* *Baehr, H.D.: Thermodynamik, Springer, Berlin, Heidelberg*

workload (h)			*L/E*
	Teaching lessons (3 SWS)	*30 h*	*30 h*
	pre- and afterwork:	*30 h*	*30 h*
	Preparation for examination:	*60 h*	
	In total:	***120 h***	

module name	Structural Durability - Polymers - Component Failure

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. M. Bonnet, Prof. Dr.-Ing. K. Segtrop
responsible	Prof. Dr.-Ing. M. Bonnet, Prof. Dr.-Ing. K. Segtrop

content	Polymers: composition and properties of polymers, polymer composite materials, additives, processing methods for plastics and fibre reinforced composites Metals: structural durability, failure mechanisms, technical failures, fracture mechanics, influencing factors on strength and fracture behaviour
learning outcome	The students • know which effects structure an composition on the properties of polymeric materials have (structure property relationship), • know common composite materials and their properties, • know how to optimise polymers by effective use of additives, • know the basics of processing methods and their influence of material properties, • understand the component failure on metals, • know the basics of structural durability, • know the influencing factors on strength and fracture behavioure
teaching methods	• lectures • exercises • laboratory work • discussion (individual)
practical laboratory work	Fracture toughness on metals, fatigue bending test, extrusion of polymer materials, tensile-test of polymer materials
language	teaching: german teaching materials: english
examination	written examination (120 min)
prerequisites	Mathematics, Mechanics, Materials
recommended literature	*Askeland, D.R.; Phule, P.P.: The Science of engineering materials* *Shackelford, J.F.: Material Science for engineers* *Callister, W. D.: Materials Science and Engineering- an Introduction*

workload (h)			*L/E*	*P*
	Teaching lessons (3 SWS)	*54 h*	*46 h*	*8 h*
	pre- and afterwork:	*36 h*	*24h*	*12 h*
	Preparation for examination:	*30 h*		
	In total:	***120 h***		

module name	New Fuels and Automotive Technologies

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. U.-M. Gundlach, Prof. Dr.-Ing. U. Langer, Prof. Dr. rer. nat. J. Stollenwerk
responsible	Prof. Dr.-Ing. U.-M. Gundlach, Prof. Dr.-Ing. U. Langer, Prof. Dr. rer. nat. J. Stollenwerk

content	- State of technology development - alternative fuels - energy sources - energy transport and storing - alternative drive train technologies - innovative power train concepts
learning outcome	The students • know the innovative and advanced automotive technologies with the special focus on technical inventions, alternative energy sources and ability of technical realization
teaching methods	• lectures with integrated exercises • excursion • laboratory work
practical laboratory work	
language	teaching: german teaching materials: english
examination	written examination (90 min)
prerequisites	Fundamentals of automotive electronics and control
recommended literature	*See detailes reference list in script*

workload (h)			*L*	*E/P*
	Teaching lessons (3 SWS)	*48 h*	*32 h*	*16 h*
	pre- and afterwork:	*48 h*	*8 h*	*40 h*
	Preparation for examination:	*24 h*		
	In total:	***120 h***		

module name	"Development of a Mechatronic System for an Automotive Application"

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. H. Ulrich
responsible	Prof. Dr.-Ing. H. Ulrich

content	Development and design of a vehicle system, Digital simulation of a vehicle system, Software development and code generating for a control unit, Data acquisition and analysis of a vehicle system and its components.
learning outcome	The students • have exercised the systematic steps to develop a vehicle system, • have specialized knowledge about single components of a vehicle system, • have improved teamwork and communication skills, • have practised purpose driven engineering work and project management, • have improved willingness to tale responsibility.
teaching methods	The module is organized as "semester project". The students work mainly on their own in teams of up to 5 persons on one complex development task out of the field of vehicle systems. The lecturer leads the project as team leader, supervises the project progress and supports the students in specialized areas.
practical laboratory work	
language	teaching: german some teaching materials: english
examination	The certification comprises four elements: • passing the agreed project`s objective • presentation of the team results • systematic documentation of the teamwork in a project file • technical discussion
prerequisites	Basic skills in team communication and project management
recommended literature	

workload (h)	*Team discussions:*	*20 h*
	Working on project:	*120 h*
	In total:	***120 h***

module name	Technology of Ma terial Flow and Robotics

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. R. Breede
responsible	Prof. Dr.-Ing. R. Breede

content	Fundamentals and applications of systems for automated material flow regarding in-plant and external logistic: Design, structural shape and functionality, parameters, flexible systems, control strategies.
learning outcome	The course enables students to select suitable system configurations for the industrial production of specific products, regarding the intended costs, flexibility and times with emphasis on automotive production.
teaching methods	x Lecture x Exercise
language	teaching: English material: english
examination	Written examination (2 h)
prerequisites	Previous knowledge of production organisation, supply chain management and automation.
recommended literature	Shell, R. L.; Hall, E. H.: Handbook of Industrial Automation, Marcel Dekker, 2000. Further literature will be recommended relating to the subject currently dealt with.

workload (h)		L	E	
	Course (3 SWS)	90 h	60 h	30 h
	Preparation and follow-up course work	30 h		
	In total:	120 h		

module name	Manufacturing Methods and Process Chains

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. Ch. Hartl
responsible	Prof. Dr.-Ing. Ch. Hartl

content	Fundamentals and applications of manufacturing technologies and process chains used for manufacturing and processing of metallic and non-metallic material (plastic components, technical glass, ceramics), composite materials, and rapid prototyping products.
learning outcome	The course enables students to select suitable manufacturing methods and process chains for industrial production of concrete products, regarding the feasibility, intended product costs, processing time and product quality.
teaching methods	x Lecture x Exercise
language	teaching: english material: english
examination	Written examination (2 h)
prerequisites	Previous knowledge of material science, engineering mechanics, physics and mathematics.
recommended literature	Groover, M. P.: Fundamentals of Modern Manufacturing: Materials, Processes and Systems, Wiley, 2006. Further literature will be recommended relating to the subject currently dealt with.

workload (h)		L	E	
	Course (3 SWS)	90 h	60 h	30 h
	Preparation and follow-up course work	30 h		
	Sum:	120 h		

module name	Technical Product Innovation

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. K. Okulicz
responsible	Prof. Dr.-Ing. K. Okulicz

content	The course will provide an innovative and holistic view of creative design. A real product innovation means new functionality, as well as new technology in manufacturing, so the course will be focused on all steps of industrial product development, from concept to manufacturing and marketing. • What is innovation in the product development process • Various models of innovation • The nature of creativity design and the design process • Methods and tools of creative design process • Methods and tools of technology assessment • Meshing the business strategy with the technology strategy • Case studies of product innovation mainly within the scope of automotive development Class project : generating and developing a new product idea in virtual environment
learning outcome	Students will gain an understanding of product innovation methods and tools. Graduates will be able to initiate and execute innovation projects.
teaching methods	Lectures, exercise, case studies, (4 SWS)
language	teaching: german teaching material: english or german
examination	Written examination with bonus points from class project and presentations
prerequisites	Broad knowledge of machine design principles, 3 D modelling, process engineering, management methods. Fundamentals of CAx.
recommended literature	Common literature on innovation management; special literature to focus on details Jonash, J., Sommerlatte, T., The Innovation Premium, Basic Books (2001) Clayton M. Christensen, Michael E. Raynor, The Innovator's Solution: Creating and Sustaining Successful Growth, Harvard Business School Press (September 2003) And others

workload (h)		*L*	*E*	*P*
Course (4 SWS)	*80 h*	*30 h*	*30 h*	*20h*
Preparation and follow-up course work	*20 h*	*20 h*		
Preparation for Examination :	*20 h*			
Sum:	**120 h**			

module name	Automotive E-Business

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. R. Mayr
responsible	Prof. Dr.-Ing. R. Mayr

content	Basic internet technologies (HTML, PHP, XML) Portal technologies, Market places and transaction technologies (BMEcat, EAN-Code, eClass), eProcurement , IT-Support for Supply Chain Management (EDI, CPFR), IT-Support for Customer Relationship Management (Database Marketing and Sales Support, Call Centre)
learning outcome	The students • know the basic methods and technologies used in internet based Applications • know what kind of methods are necessary in a collaborative B2B and B2C production world • know the interaction between Internet applications and existing ERP backend environments
teaching methods	Lecture (3 SWS) in English language
language	english
examination	Written examination (duration 60 min)
prerequisites	Knowledge in basic principles in Information Technology and ERP-systems
recommended literature	Argerich et all: Professional PHP4 XML, Wrox Press 2002 Norris, Hurley, Hartley: E-Business und ERP, Wiley 2001 Zwißler: Electronic Commerce Electronic Business, Springer 2002 Röhricht, Schlögel: cBusiness, Addison Wesley, 2001

workload (h)		*L/E*	*P*	
	Course (3 SWS)	*54 h*	*54 h*	*-*
	Preparation and follow-up course work	*26 h*	*26 h*	*-*
	Preparation for Examination :	*40 h*		
	Sum:	**120 h**		

module name	Advanced Quality Management (QM)

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. S. Bracke
responsible	Prof. Dr.-Ing. S. Bracke

content	The students shall understand the Approaches and Strategies of Total Quality Management. Furthermore the Focus is the Application of technical Methods and Tools for effective Total Quality Management particularly those commonly used in the Automotive Industry.
learning outcome	The Students know x Fundamentals of Total Quality Management and Business Excellence x Total Quality Management Approaches and Strategies x Zero Defects Concept x Six Sigma x Continuous Improvement x Balanced Score Card x Benchmarking x Lessons Learned x Tools of Quality Management (classical and new Tools) x Fundamentals of TQM-Implementation x Quality Planning und Quality Control in Automotive Industrial Practice
teaching methods	x Lecture, including Exercises and Workshop with Presentation realized by Students x Learning in small Groups x (Company Excursion) x Guest Lecturer
language	English
examination	Written examination; 25% of the Result is influenced by the Presentation realized by Students
prerequisites	Fundamentals of Quality Management
recommended literature	Pyzdek: The Six SIGMA Handbook, Publisher: Mcgraw-Hill Professional; Edition: Rev Exp (2003) Pfeifer, Thilo: Quality Management. Strategies, Methods, Techniques, Publisher: Hanser Fachbuchverlag, Edition: 2001 Geiger, Walter: Handbuch Qualität, Publisher: Vieweg-Verlag; Edition: 4., April 2005 Kamiske, Gerd F.: Qualitätsmanagement von A-Z, Hanser Verlag, Edition 5., 2005

workload (h)		L	E	P	
	Course (4 SWS)	64 h	48 h	16 h	-
	Preparation and follow-up course work	40 h	32 h	8 h	-
	Preparation for Examination : 16 h				
	Sum: 120 h				

module name	Automotive Marketing and CRM

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. M. Matoni
responsible	Prof. Dr.-Ing. M. Matoni

content	General marketing aspects: segmentation, marketing instruments; aspects of the fascination of automobiles: mobility / prestige / experience / design / self realization; specialities of Automotive Marketing: customer segments, marketing mix; brand identification, advertising, racing business; Customer relationship Management
learning outcome	The students • understand the general aspects of Marketing to analyse customer needs and behaviour, • understand the speciality of Automotive Marketing with aspects of brand/fashion/prestige/mobility etc., • know aspects of the different tools to form customer needs into construction instructions, • know how to measure strategic management situation
teaching methods	• lectures • exercises • project work / case studies • discussion (individual)
practical laboratory work	
language	teaching: German teaching materials: English
examination	- written examination (120 min) - successful participation to practicum is precondition for examination
prerequisites	Basics in Economics and Marketing
recommended literature	*Kottler: Marketing Management* *Ebel, Hofer, Al-sibai: Automotive Management, Springer Verlag 2003*

workload (h)			*L/E*
	Teaching lessons (3 SWS)	*72 h*	*72 h*
	pre- and afterwork:	*24 h*	*24h*
	Preparation for examination:	*24 h*	
	In total:	***120 h***	

module name	Strategic Automotive Management

credits	4
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	Prof. Dr.-Ing. M. Matoni
responsible	Prof. Dr.-Ing. M. Matoni

content	General Automotive Strategic Management: Process of leadership and executive function, corporate strategy of OEM / suppliers; National / international aspects of automotive business; networks of automotive business; make -or-buy, flexibility, cots, business and operating models
learning outcome	The students • understand speciality of strategic basics in automotive business, • understand the different strategic approach of international acting enterprises, • understand the techniques for analyzing industries and competitors, • know aspects for questioning to leadership, • know how to measure strategic management situation
teaching methods	• lectures • exercises • project work / case studies • discussion (individual)
practical laboratory work	
language	teaching: German teaching materials: English
examination	- written examination (120 min) - successful participation to practicum is precondition for examination
prerequisites	Basics in Economics and Marketing
recommended literature	*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*

workload (h)			*L/E*
	Teaching lessons (3 SWS)	*72 h*	*72 h*
	pre- and afterwork:	*24 h*	*24h*
	Preparation for examination:	*24 h*	
	In total:	***120 h***	

module name	Elective III: Project

credits	6
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	All lecturers of the faculty
responsible	Prof. Dr. rer. nat. G. Ise

content	The Students can choose a specified nature of a technical task from the following 6 areas: • Product Development (Profile R & D) • Computer Aided Simulation (Profile R & D) • Testing • Troubleshooting • Maintenance (Profile Production) • Manufacturing (Profile Production)
learning outcome	The Students are able to • use systematic steps to solve a specified technical task • use problem-orientated application of the theoretical knowledge • do Teamwork (communication, project planning, project management) • work towards agreed goals • have a high sense of responsibility
teaching methods	The Students will work together in groups of 4 to 5 people on a specified task from the area of automotive research and development (Profile R & D) or automotive production and manufacturing management (Profile Production). Lecturers will offer support when needed (max. 1 SWS).
examination	Written report documenting the project execution and results Presentation with discussion English recommended for all written communication. Final reports and presentation can be prepared in English with agreement of the lecturer.
prerequisites	Knowledge of the relevant CA systems where applicable
recommended literature	Depending on the subject area Special literature to focus on details

workload (h)	*Project work* *120 h* *Documentation and presentation :* *60 h* In total: **180 h**

module name	Elective III: Project

credits	6
designated degree	Master of Science Automotive Engineering 2. Semester
lecturer	All lecturers of the faculty
responsible	Prof. Dr. rer. nat. G. Ise

content	The Students can choose a specified nature of a technical task from the following 6 areas: x Product Development (Profile R & D) x Computer Aided Simulation (Profile R & D) x Testing x Troubleshooting x Maintenance (Profile Production) x Manufacturing (Profile Production)
learning outcome	The Students are able to x use systematic steps to solve a specified technical task x use problem-orientated application of the theoretical knowledge x do Teamwork (communication, project planning, project management) x work towards agreed goals x have a high sense of responsibility
teaching methods	The Students will work together in groups of 4 to 5 people on a specified task from the area of automotive research and development (Profile R & D) or automotive production and manufacturing management (Profile Production). Lecturers will offer support when needed (max. 1 SWS).
language	English is recommended for all written communication. Final reports and presentations can be prepared in English with agreement of the coach.
examination	Written report documenting the project execution and results Presentation with discussion English recommended for all written communication. Final reports and presentation can be prepared in English with agreement of the lecturer.
prerequisites	Knowledge of the relevant CA systems where applicable
recommended literature	Depending on the subject area Special literature to focus on details

workload (h)	Project work 120 h Documentation and presentation : 60 h In total: 180 h