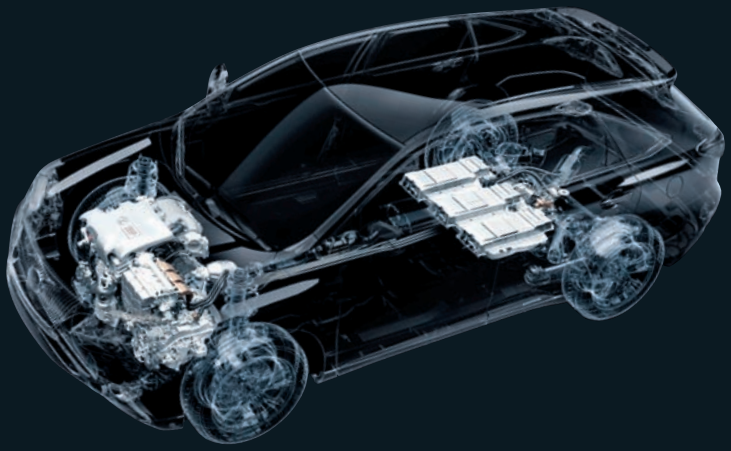


Automotive Vehicle Integration
Powertrain and Chassis Engineering
Master of Engineering

FACULTY 06
AEROSPACE ENGINEERING

FH AACHEN
UNIVERSITY OF APPLIED SCIENCES

Automotive Vehicle Integration

Before you start

The practical degree programme

General Information

You will find all relevant information with respect to the course of studies Automotive Vehicle Integration in the internet. For that purpose, just photograph the QR code and use the adequate reader of your mobile phone*.

* Please note: Costs may arise upon initiating the web page.

Introducing the degree programme

Dear prospective students, dear students, dear future automobile experts,

thank you for your interest in our international Master Courses Automotive Vehicle Integration/ Powertrain and Chassis Engineering.

The positive rapid development within the automotive-field, can be observed both by the implementation of high technologies and by the job market aspects, can be affirmed by numerous press and corporate announcements. Additionally triggered by the restructuring in the automotive production process new-concept study courses are becoming essential, which will qualify the future engineers with improved know-how, that is adapted to the industry recent needs.

Automobile manufacturers do not develop and produce all the products' components (modules) in-house anymore; they rather assign these tasks to suitable outsourcing-partners. The shifting of system competence to suppliers changes also the qualification profile of the future engineers employed by both the manufacturers and the suppliers. The tasks of an engineer extend successively beyond the construction problems into project management, test-bench operation or software design of virtual product development and above all system integration capabilities.

The FH Aachen with its master courses Automotive Vehicle Integration as:

- 3-semesters course (without Research Semester) or
- 4-semesters course (including Research Semester)

realises these demands of education.

We are looking forward to welcome you as students of the FH Aachen.

Yours sincerely,

Prof. Dr.-Ing. Thomas Esch
Course Director

Automotive
Vehicle Integration

Vehicle Integration
From individual modules to a functioning whole vehicle

Vehicle Integration Teams keep an eye on the entire development process. Organizing projects in an economical manner is just as important as fulfilling all technical requirements.

The Vehicle Integration Team controls and monitors the defined requirements for vehicle safety, fuel consumption, emissions, acoustics and aerodynamics throughout the entire development process: from design, simulation, testing and validation to certification across all modules. It ensures the mechanical integration, the wedding of the powertrain/chassis system and the body while integrating electronic/electric systems and taking care of the homologation activities.

In order to plan for validation of developments, it is important to establish project plans controlling the entire course of the project and covering all modules and functions. How many prototypes are needed? Which tests can be performed using which prototypes? Together with the experts from all disciplines, the Vehicle Integration Team taps into synergy effects in order to reduce the prototype cost. The goal is to apply a development plan that is both time and cost effective.

In order to comply with legal requirements, the Vehicle Integration Team ensures access to all applicable laws worldwide concerning vehicle development and supports the individual departments in their development efforts.

CAE
From the first planning idea to a functional, virtual prototype

Technical Calculation Teams ensure that functional requirements for individual vehicle modules are fulfilled all the way through the whole vehicle, prior even to construction of the first prototype. Based on the DMU synchronization products, all relevant functions, such as vehicle safety, acoustics, aerodynamics, fuel consumption, exhaust emissions, operational stability, and rigidity of vehicle parts are tested virtually. Results from the technical calculation enable to define ideal solution suggestions for the construction and the subsequent practical application to the prototype. Installation space analysis and packaging studies are also virtual part of a full vehicle integration process.

Today‘s hardware infrastructure consisting of several computer clusters allows providing calculation and optimization results within a very limited amount of time. Furthermore, the Technical Calculation Teams constantly work on optimizing the internal process times by programming their software tools accordingly. By working closely with the Testing Division Teams, intensive validations are performed to optimize simulation methods and explore new subject areas.

Technical calculations are a vital success factor in validating all functional requirements within a limited amount of time.

Testing and Validation

Anything that is meant to go into production has to pass laboratory tests

In Testing Laboratories, virtual simulation results are tested and validated under real conditions. Whether single assemblies or the whole vehicle are tested, testing equipment enables to simulate any possible impact on the vehicle later on in real life situations (mechanical tests and environmental simulations, functional and life span tests of e.g. engine and transmission, vibroacoustic appraisals, passive vehicle safety, vehicle trials, ...).

Testing and Validation Teams are a vital part of the integrated development process. It is integrated with the Technical Calculation Teams and focuses on validating and confirming virtual simulation results. Testing results are immediately fed back to development and contribute to constant quality enhancement. There are no compromises for companies when it comes to quality.

From creating specifications and continuous development controlling, defining methods to documenting testing results in detail, the Vehicle Integration Teams ensure that tests are conducted with the required intent. Test results are used to benchmark the whole vehicle.

Electrics/Electronics
Integrated solutions for tomorrow's demands

Working on the basis of a requirement analysis, Electrics/Electronic Integration Teams work out concepts ranging from the definition of the electric/electronic architecture, or the development of hard and software, through to vehicle integration. By carrying out checks and tests on both software and hardware components throughout the development and production phases, the team guarantees ready-for-production solutions.

The electric design and development of the vehicle's electrical system are further elements in the service spectrum. They cover all relevant process stages, from the development of the concept for the electrical system, cable routing and component design through to the management of the suppliers concerned.

Besides designing space requirements (package) and parts (e.g. electric/electronic components, cable harnesses, actuator/sensor technology, etc.) the Electronic Development Teams develop complete control units, and guarantee their integration within the network of all the systems in the vehicle. Daily work is characterised by the frequent use of bus systems such as CAN, LIN, Most or Bluetooth, and their corresponding tools.

The focus of Electronic Development Team is on the development of safe, embedded systems in accordance with the IEC and ISO standard.

The functional safety in the vehicle is greatly enhanced not only by the growing number of driver assistance systems, but also due to ever-increasing demands on passenger and pedestrian protection.

Project Management – the Nerve Center

The challenge is bringing together customers, system developers and partners to work as an integrated team. To this end, minimizing and supporting the interface is one of the key factors. Development projects need to be well-structured and effectively organized so that their complexity remains at a controllable level, and deadlines, budgets and pre-defined quality goals can be met. For successful project management, this is the guiding principle.

Planning, continued testing, recognizing optimization potential and regulation make up the control system Project Management Teams have mastered. At the same time, standardized management methods have to be utilized that enable to adjust to individual client processes.

Project Management Teams ensure a project is handled optimally by establishing a clear analysis of customer requirements, defining product oriented responsibilities and by matching expectations with industry-specific application of each individual task.

Career fields

The qualifications required in development departments of automobile industry are not to be interpreted as pure technical CAE tasks. The range of the performance extends recently far beyond that into project management, testing operation, development of software tools, etc. The development processes in the automobile engineering segment can be divided in 5 main phases:

- Design/Construction
- CAE Verification (simulation, computation, prototyping, development)
- Testing and Validation
- Homologation
- Project Management

The courses of Automotive-Master focus on the integration of powertrain systems– consisting of engine and transmission – as well as the integration of chassis systems into the complete vehicle concept.

The graduates of the Master Courses practically undertake a variety of application orientated tasks in module integration, development, construction and manufacturing of automobile systems. They plan, calculate and produce intelligent co-operating mechanical, electronic and technical information components and integrate them spatial- and functionally with methods from the mechanical, electrical and information engineering in the automobiles. Recently these belong to the most physically- and technically complex machines.

The graduates will therefore find their jobs at manufacturers and suppliers of the automobile industry predominantly in vehicle integration teams to aim low fuel consumption, low emissions, low engine and vehicle noise, as well as high comfort and performance.

Career opportunities

Due to current inquires most German companies are looking for engineers with rising tendency! In Germany about one of seven jobs depends on the automobile industry: This industry is still considered as one of the strongest job machines. Especially the need for experts with know-how in vehicle integration was covered insufficiently in the past years.

As result of the high scientific requirement of the study courses the graduates are able to independently solve field specific problems in product development, as well as in scientific research and are thereby suitable for leading positions.

The master degree of the FH Aachen grants an access to a higher public service level to provide the graduates with optimal conditions to begin a career as a German government employee.

Alternatively the Masters of Engineering can find their place in the application orientated research or continue to study a doctorate programme (PhD) at a technical university.

In addition also the capabilities of entrepreneurial ways of thinking will be trained during the study. With appropriate field specific knowledge, personal qualifications and motivation can self-employment also be a career opportunity.

Competences

The study to the „Master of Automotive Vehicle Integration - Powertrain and Chassis Engineering“ is based on two unique-characteristics:

- The integration of powertrain and chassis systems into the complete automobile is deemed to be the principal guidelines by the lectures, exercises and practical sessions of the courses. This content-wise focussing considers the changed requirements of the manufacturers and suppliers in system integration and interface definition in the automobile manufacturing industry.
- The study in the qualification network group with selected partners from industry and research (i.e. FEV engine technology - Aachen, ETAS Group - Stuttgart and Magna Steyr - Graz) secures a high practical relation to the study contents, which constantly orients itself at the need of the industry.

In accordance with study- and examination regulations the three-semester master course (without Research semester) - with regard to the study contents and programme duration- builds consecutively on the seven-semester bachelor course „Automotive Automotive Power Train Engineering and Automotive Chassis Engineering“. The master courses deepen and extend the modules-coherences from the bachelor course. The study programme can still be studied consecutively with a professional working experience between the bachelor and master course.

The master courses of „Automotive Vehicle Integration“ are consecutive application orientated programmes. The programme contents, the scientific qualification of the instructors, the equipment and the connections of the university with the industry support the application orientation of the study. The graduates of this master programme will be granted the title “Master of Engineering” (M. Eng.).

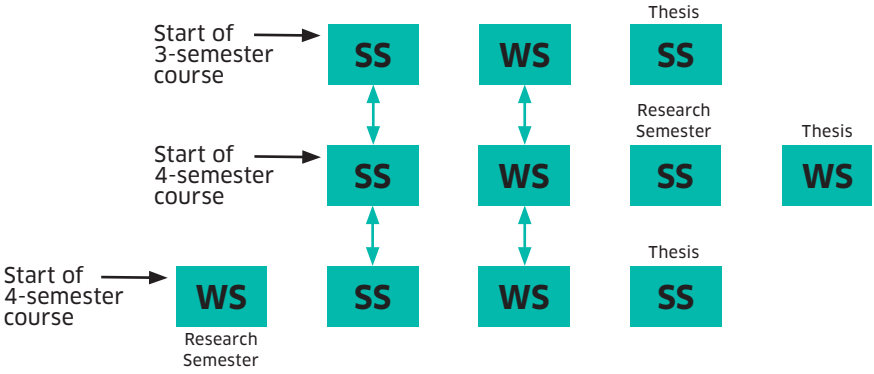
Before you start

Admission requirements

Only applicants with the following qualifications can be considered to the application procedure:

- an excellent Bachelor-degree (B. Sc.) in Automotive-Engineering or Mechanical-Engineering with correspondingly major-study. Applicant with a degree of a six-semesters Bachelor study can only apply for the four-semester master programme (including Research Semester)
- an excellent Diplom-Ingenieur-degree (Dipl.-Ing. FH or TU/TH) in Automotive-Engineering or Mechanical-Engineering with correspondingly major-study
- an excellent University-degree in another equivalent engineering study
- Applicants, whose study qualification was not achieved at German speaking university have to send a certified copy of the „Graduate Record Examination (GRE) - General Test"-result and proof of German language skill as "Zertifikat Deutsch (B1)"-certificate
- Proof of English language skill (TOEFL/IELTS)
- Applicants who already have practical experience in the Engineering field (internship, jobs) are asked to provide proof of such achievements and/or activities.
- a Letter of Motivation (max. one page, font size 12pt) describing the reasons and motivations for the study at the FH Aachen.

Detailed information can be found at *www.fb6.fh-aachen.de/luft-und-raumfahrttechnik/master-english/application/*



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The scientific degree programme Automotive Vehicle Integration

Course profile

The three / four semester course of studies to the automotive master mediate methods and techniques of the range vehicle integration/powertrain and chassis. Both the three and four semester master courses are successfully accredited by the AQAS e.v.

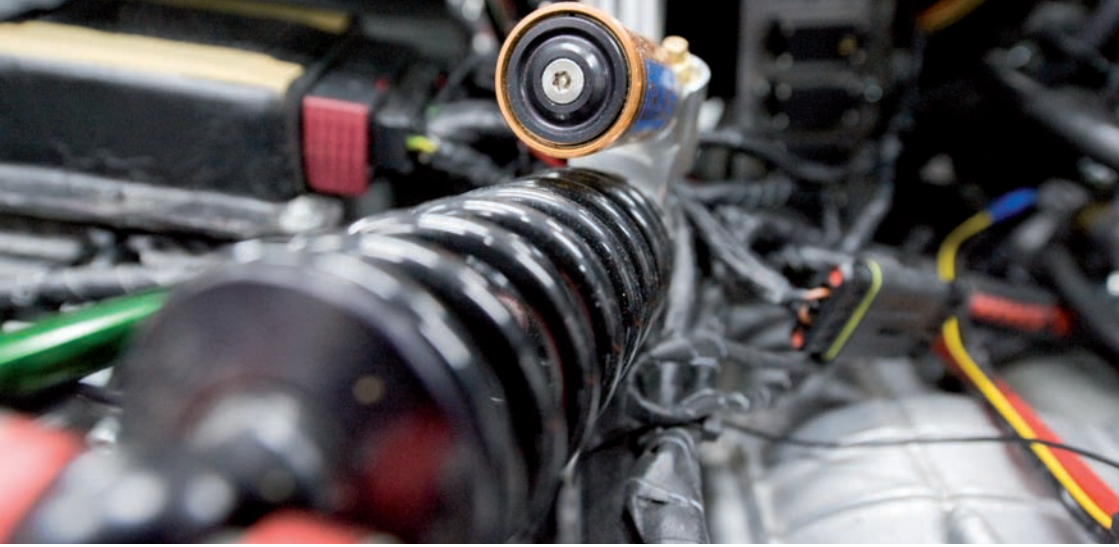
The study deepens the engineer-scientific basics like Advanced Mathematics, Mathematical Optimisation, Advanced Control Technology, Advanced CAD-Methods, Advanced Finite Element Methods, Structure Dynamics, as well as in Test Scheduling, Measurement and Control Systems.

With the decision for the automotive master, the students extend their specialized knowledge with contents like:

Vehicle Integration 2 | Powertrain types and positioning, engine compartment packaging, process development (VPP), Portfolio planning, engine life cycles, definition and development of powertrain attributes, interface management

Vehicle Dynamics and Multibody Systems Simulation | Multibody Systems Simulation (MBS), model definition relative to vibration of vehicle components, determination of vehicle dynamics characteristic data, operating stability calculations, comparison simulation/measurement in driving attempts

Automobile Electronic Systems | base knowledge of up-to-date sensors and actuators, microprocessor-based control systems, cross-linking methods using modern bus-systems, wiring, safety requirements



Environmental Problems of Vehicle Powertrain | exhaust emissions regulations of the European Union and the USA, operating conditions and the exhaust gas of petrol and diesel engines, exhaust gases after treatment, alternative vehicle powertrain, fuels for future driving systems

Vehicle Calibration | engine management (petrol and Diesel), optimization strategies for cold-starting, warm up, idle operation and driveability, highly developed combustion technologies, OBD calibration, transmission calibration, vehicle calibration methods and tools

Vehicle Acoustics | Environmental impact by motor vehicle noise, physical and audiological bases, acoustic measuring techniques, regulations, noise reduction measures, psychoacoustic

Production Release and Homologation | regulations, guidelines, whole-vehicle approval - Powertrain, measuring regulations, measuring expirations, test algorithm/systems, documentation, knowledge management, certifying

The courses are supplemented by soft-skill modules "General Competence" e.g. foreign languages, Patent Rights for Engineers, Entrepreneurship, Project Management and Time Management.

The internationality of the Master Course will be offered also by means of the instruction language, which is English.

The study ends with a project-orientated master thesis.

Curriculum without research semester

No.	Name of Module	C/E	Cr	SWS L	SWS T	SWS Lab	SWS SU	SWS ∑
1st Semester (summer term)								
61301	Advanced Mathematics	C	4	2	2	0	0	**4**
61302	Mathematical Optimisation	C	5	2	1	1	0	**4**
61303	Advanced Control Technology	C	4	2	1	0	0	**3**
61304	Advanced CAD	C	4	0	0	3	0	**3**
61305	Environmental Problems of Vehicle Powertrain	C	4	2	1	1	0	**4**
61306	Automobile Electronical Systems	C	5	2	1	1	0	**4**
61307	Vehicle Acoustics	C	4	2	1	1	0	**4**
Total			**30**	**12**	**7**	**7**	**0**	**26**
2nd Semester (winter term)								
62301	Test Scheduling, Measurement and Control Systems	C	4	2	0	2	0	**4**
62302	Structural Dynamics	C	5	2	1	1	0	**4**
62303	Advanced Finite Element Methods	C	4	2	0	1	0	**3**
62304	Vehicle Integration 2	C	4	2	1	0	0	**3**
62305	Vehicle Dynamics and Multi-Body-System Simulation	C	5	2	1	1	0	**4**
62306	Vehicle Calibration	C	5	3	1	1	0	**5**
62307	Production Release and Homologation	C	3	2	0	0	0	**2**
Total			**30**	**15**	**4**	**6**	**0**	**25**
3rd Semester (summer term)								
6xxxx	2 elective modules from Catalogue 1	E	4	0	0	0	4	**4**
	Project orientated Master Thesis		26	0	0	0	21	**21**
Total			**30**	**0**	**0**	**0**	**25**	**25**

Cr: Credits
L: Lecture
C: Compulsory
T: Tutorial
E: Elective
Lab: Laboratory
SWS: Contact hours per week
SU: Seminar

Curriculum including research semester

No.	Name of Module	C/E	Cr	SWS L	T	Lab	SU	∑
1st Semester (summer term)								
61301	Advanced Mathematics	C	4	2	2	0	0	**4**
61302	Mathematical Optimisation	C	5	2	1	1	0	**4**
61303	Advanced Control Technology	C	4	2	1	0	0	**3**
61304	Advanced CAD	C	4	0	0	3	0	**3**
61305	Env. Problems of Vehicle Powertrain	C	4	2	1	1	0	**4**
61306	Automobile Electronical Systems	C	5	2	1	1	0	**4**
61307	Vehicle Acoustics	C	4	2	1	1	0	**4**
Total			**30**	**12**	**7**	**7**	**0**	**26**
2nd Semester (winter term)								
62301	Test Scheduling, Measurement and Control Systems	C	4	2	0	2	0	**4**
62302	Structural Dynamics	C	5	2	1	1	0	**4**
62303	Advanced Finite Element Methods	C	4	2	0	1	0	**3**
62304	Vehicle Integration 2	C	4	2	1	0	0	**3**
62305	Vehicle Dynamics and Multi-Body-System Simulation	C	5	2	1	1	0	**4**
62306	Vehicle Calibration	C	5	3	1	1	0	**5**
62307	Production Release and Homologation	C	3	2	0	0	0	**2**
Total			**30**	**15**	**4**	**6**	**0**	**25**
3rd Semester (summer term)								
63300	Research Semester	C	30	0	0	0	25	**25**
Total			**30**	**0**	**0**	**0**	**25**	**25**
4th Semester (winter term)								
6xxxx	2 elective modules from Catalogue 1	E	4	0	0	0	4	**4**
	Project-oriented Master Thesis		26	0	0	0	21	**21**
Total			**30**	**0**	**0**	**0**	**25**	**25**

Cr: Credits
L: Lecture
C: Compulsory
T: Tutorial
E: Elective
Lab: Laboratory
SWS: Contact hours per week
SU: Seminar

Module Catalogue

No.	Name of Module	C/E	Cr	SWS L	SWS T	SWS Lab	SWS SU	SWS ∑
Module Catalogue 1 („General Soft Skills“)								
63702	Entrepreneurship	E	2	0	0	0	2	**2**
63703	Project Management	E	2	0	0	0	2	**2**
63705	Time Management	E	2	0	0	0	2	**2**
63706	Successful Personal Marketing	E	2	0	0	0	2	**2**
66566	Technical German	E	2	0	0	0	2	**2**
66567	Six Sigma	E	2	0	0	0	2	**2**
63701	Patent Rights for Engineers	E	2	0	0	0	2	**2**

Cr: Credits
L: Lecture
C: Compulsory
T: Tutorial
E: Elective
Lab: Laboratory
SWS: Contact hours per week
SU: Seminar

Modules

61301 **4 Credits**

Advanced Mathematics | *Prof. Dr. rer. nat. Christa Polaczek*

Acquisition of the basic mathematical and information technological knowledge of the subjects mentioned below, and the qualification for independent application of this knowledge to engineering problems.
For the solution of linear differential equations the Laplace transform is presented. Bases of the Fourier Series are presented. The vector analysis is treated up to the integral theorems. Based on this knowledge partial differential equations are introduced as well as the most important partial differential equations for practical applications are treated; the letter includes tensor calculus formulations.

61302 **5 Credits**

Mathematical Optimisation | *Prof. Dr. rer. nat. Klaus-Gerd Bullerschen*

Acquisition of the basic mathematical and information technological knowledge of the subjects mentioned below and the qualification for the independent application of this knowledge to engineering and business management problems.
Calculation of the extreme values of scalar functions for varying constellations of domains and functional dependencies. Especially linear optimization (for linear mappings with domains defined by linear inequations) by using the simplex algorithm, nonlinear optimization (for nonlinear mappings) performed by differential calculus or search methods, discrete optimization (for finite number of alternatives like paths in a graph) with suitable algorithms. Useful transformations between these three basic problem classes. Utilization of software tools for solving optimization problems of large-scale calculation expenditure.

61303 **4 Credits**

Advanced Control Technology | *Prof. Dipl.-Ing. J.-Michael Bauschat*

State-vector control, stability augmentation systems, command systems, elimination of disturbances, intermeshed control loops, pilot control, cascade control, interacting control, time-varying and nonlinear control systems, two-step and three-step controllers, design criteria, control effectiveness, root locus, adjustment rules, stability of closed-loop systems, stability

criteria, fuzzy-control, control loop design with MATLAB and SIMULINK.

61304 **4 Credits**

Advanced CAD Methods | *Prof. Dr.-Ing. Hans-Josef Cordewiner, Dipl.-Ing. Helmut Lieben, Dipl.-Ing. Wilhelm Douven*

The students are enabled to autonomously generate complex, virtual surface models for further use in interdisciplinary applications. This covers construction of prototypes, investigations on the behaviour in operation (e.g. static and dynamic analyses of components, crash simulation), and manufacturing methods (e.g. NC technology, Rapid Prototyping).
Based on the specific needs of aerospace, as well as the car body technology, the students in the courses study the generation and modification, assembly and the analysis of complex curves and surfaces as well as the integration of solids into the surface assemblies.

61305 **4 Credits**

Environmental Problems of Vehicle Powertrain | *Prof. Dr.-Ing. Thomas Esch*

Mobility is a way of human life. Traffic is indispensable; it is the engine of our economics and the pulse, which determine our life. Since long it has become a criterion of our prosperity. The advantages of individual mobility are bought however by disadvantages for the environment. This lecture describes the up-to-date regulations, which are undertaken by the legislator of automobile industry, in order to limit the effects of the increasing auto traffic with internal combustion engines. This lecture focuses on pollutants in the exhaust gas of combustion engines, on the existing exhaust regulations of the European Union and USA – California and test procedures, on technological solutions to minimize CO2 emissions of automotive vehicles, on exhaust after-treatment technologies of combustion engines and on alternative fuels for future powertrain systems.

61306 **5 Credits**

Automobile Electronic Systems | *Prof. Dr.-Ing. Günter Schmitz*

In the course of this module first the basic principles of modern (smart) sensors and actuators as well as their interaction in complex systems are shown. Interfacing circuits are discussed as well as microprocessor based Electronic Control Units (ECUs). The close coherence between electrical and mechanical subsystems is addressed. In practical examples especially the control of the internal combustion engine in the vehicle the function of the complete system is studied. The networking and as well the safety aspects of modern control systems in vehicle applications are discussed.

61307 **4 Credits**

Vehicle Acoustics | *Prof. Dr.-Ing. Jan-Welm Biermann*

Introduction to the physical and audiological background of the vehicle acoustics (definition and units in the acoustics). Authority in handling the relevant legally valid measuring regulations, the measuring procedures (sensors, measuring instruments, spatial measurements, signal analysis) as well as the permissible limit values. Capability to understand in how far the vehicle manufacturers, operators as well as legislators can create an influence to decrease the traffic noise. Automobile specific sources of noise e.g. powertrain, chassis, body (sound formation, realizable noise reduction measures) and psychoacoustics. Competence to implement noise reduction measures through research project will be also shown.

62301 **4 Credits**

Test Scheduling, Measurement and Control Systems | *Prof. Dr.-Ing. Thomas Franke*

The practical ability

- to design, program and operate computer controlled measurement chains
- to organize experiments and to apply sensors specific for automotive or aerospace application

Using the graphical programming language "LabVIEW" the student should learn

- to acquire, to evaluate und to display graphically any analog and digital measuring value,
- to generate analog and digital control values and to transmit them to an external hardware.

Basics of the LabVIEW-programming und the data acquiring hardware inside and outside of the personal computer will be discussed for an optimized organization of experiments.
The function of all in specific sensors of the aerospace or automotive industry used the practical training will be discussed in detail. Above of it the instrument control using USB, GPIB and RS232 interfaces and the numerical evaluation of pictures will be introduced.

62302 **5 Credits**

Structural Dynamics | *Prof. Dr.-Ing. Michael Wahle*

First the mathematical and physical fundamentals of the finite element method (FEM) are presented and deepened based on simple examples. The different possibilities of damping and mass matrixes in the structural analysis are treated in particular. The training and/or consideration of test results for the entire and parts of structures and/or their components is brought up. The model validation on the basis of the experimental modal analysis is treated. Along with the modal analysis will the computation variants of forced oscillations for different kinds of suggestion become (transient by means of gradual integration; harmonic to random modal and not model oscillations) theoretically stated and deepen using examples. Critical cases from practice experience will be discussed. For different setting of tasks in the context of the practical course, complex finite element models with ANSYS are

provided and the different computation possibilities are discussed.

62303 **4 Credits**

Advanced Finite Element Methods | *Prof. Dr.-Ing. Jörn Harder*

The aim of this course is (based on the knowledge of the bachelor course „FEM-Grundlagen“ for the FE treatment of linear problems) that the students acquire the capability to solve more complex structural mechanics tasks (nonlinear problems, stability problems). Moreover the students should gain a deeper understanding of the universality of the finite element method by the treatment of another class of field problems, namely heat conduction problems. This should also enable the students to analyse thermal stresses by consecutively performing stress analyses.

At the same time a suitable choice of models and element types should make the students become acquainted with procedures to analyse typical components of the aerospace / automotive field under complex load conditions (e.g. high-temperature- and lightweight- components, in particular also shell structures made of fibre-reinforced materials). Beyond the students should gain an improved understanding of the interdisciplinary character of state of the art engineering tasks.

In the practical trainings the students should deepen the acquired theoretical knowledge by exemplarily performing FE-analyses (or essential parts of it) of close to reality examples. At the same time the capacity for teamwork and social competence shall be practised by executing the practical tasks in small groups.

62304 **4 Credits**

Vehicle Integration 2 | *Prof. Dr.-Ing. Thilo Röth, Dipl.-Ing. Thomas von Reth*

The instructional contents concentrate on all technical and customer-oriented interests, which are of importance for the integration and interaction of the powertrain with the whole vehicle. Basic knowledge for the function mode of the „base engine“ is presupposed and „refurbished“ in a short outline. In detail are instructional contents:

- Powertrain systems and positioning, engine compartment packaging (in particular engine frame and storage, accessories, air intake and exhaust systems turbocharging, cooling and heater/air conditioner, transmissions and drive strand, engine compartment air flow)
- Special propulsion principles (in particular Natural Gas (CNG), Liquified Petrol Gas (LPG), hydrogen, hybrid)
- Development processes (VPP), Portfolio planning, engine life cycles
- Definition, development of drive strand attributes (in particular road performance, consumption, driveability, traction, moment distribution, exhaust gas) as well as the interaction on total vehicle attributes (in particular noise, security, oscillations, dynamic disturbances, firmness)
- Development processes, methods and tools particularly to the topic field
- Interface management driver, and/or customer
- Product design and manufacturing strategies
- Drive-strand-relevant vehicle application, in particular in the exercise instructional contents on the basis examples in line with standard usage are clarified

62305 **5 Credits**

Vehicle Dynamics and Mutlibody System Simulation | *Prof. Dr.-Ing. Michael Wahle*

First the mathematical and physical fundamentals of the multibody simulation (MBS) are presented and deepened based on simple examples. Overview of commercially available software regarding to mathematical algorithms. Model description of vibration relevant components such as springs, dampers, rubber mounts and hydraulic mounts. Determination of relevant model parameters for the calculations. Use of the software SIMPACK for simulation of various vehicle components and vibration analysis. Comparison of the results with analytical solutions/ approximations. Driving comfort, safety and interface forces will also be considered. Simulation and measurements during vehicle driving trials.

62306 **5 Credits**

Vehicle Calibration | *Dipl.-Ing. Rolf Weinowski, Dipl.-Ing. Thomas Körfer, Dr. Kai Matthias Pinnow*

Knowledge of the technical background the vehicle calibration as well as authority in handling the calibration tools. Capability to the independent functional change and data input of the functions regarding driveability, fuel consumption, pollutant emissions and acoustics. Authority for the independent function draft and implementation and test of new motor control functions. Team ability and social authority in interdisciplinary teams.

Vehicle analysis (original data), requirements (internal ones, legal ones), requirement management.

Powertrain (conflicting aims, work statement), development strategy (petrol -, diesel engines), ignition conditionos (cold weather starting, warm start), idle operation behaviour, driveability (engine performance, responsing mode, engine dynamics, shifting process, shifting attitude, comfort), consumption optimization, emission regulation (exhaust gas, oxidation catalyst, particle filter, regeneration processes, conflicting aims), function and data input development (Software / Hardware Tool, characteristic diagrams, motor control variable), validating of Software functions, data, Hardware /Software model, Rapid Prototyping Tools, HIL/ SIL, determination of the error tolerance, examination of the system performance, error analysis, exercises, practical course attempts, driving attempts.

62307 **3 Credits**

Mass Production Release and Homologation | *Dipl.-Ing. Wolfgang Wister*

Knowledge of the up-to-date valid regulations (European Union, ECE, StVO) and guidelines regarding automobile emissions, noise, consumption, security and reliability. Authority in handling with different vehicle test algorithms and systems, which must be accomplished according to standardized measuring regulations. Team ability and social authority in interdisciplinary teams.

Regulations (European Union guidelines, ECE regulations, StVZO), guidelines (emission and OBD, noise, consumption, security, reliability), types of Homologation (total vehicle -, spare part -, accessories), whole vehicle homologation - Powertrain (passive security, engine -, steering column displacement with crash, pedestrian protection), measuring regulations, measuring expirations (chassis dyno, driver rehearsing), test algorithm/systems, documentation, knowledge management, certifying.

63300 **30 Credits**

Research-Semester

By choosing a four-semester master course (including Research Semester), the student is required to achieve one of the following options in order to earn a master degree:

- an internship with duration of 24 weeks in an industrial enterprise including the pre- and wrap-up meetings. The internship must contain engineer activities within the range of system integration in an enterprise of the vehicle technology. The arrangement of the practical course is co-ordinated with the respective qualification profile of the student and must be agrees upon in the procedure of admission with the study advisor of the university department. The study advisor supports the student also with the search for a suitable placement. Over the research semester a report is to produce as well as conclusion presentation or
- one interdisciplinary research project in one of the offered project teams at the Aachen University of Applied Sciences with duration of 24 weeks. Regarding the arrangement of the activities within the research project as well as their conclusion presentation, the accordingly regulations as for the industrial internship is applied.

The Research Semester serves the goal to introduce the students with already acquired basic knowledge to engineer-moderate working. This requires a continuous cooperation to one or more small projects. The work portion of the students is to be thereby not only subordinated nature, but approximate from the quality that of an engineer.
The Research Semester offers the possibility for the students to use the knowledge and abilities acquired in the past study and to reflect and evaluate afterwards the experiences made with the practical activity.
In advance to the Research Semester the Department of Aerospace Engineering offers in October, once a year an integration course in “German Life and Business Culture” for all the new students.

General Competencies
To strengthen also the soft-skill qualification of the students the study is supplemented by multidisciplinary modules e.g.:

- Technical German
- Entrepreneurship
- Patent Rights for Engineers
- Project Management
- Time Management
- Succesful Personal Marketing
- Six Sigma.

General Information

Organisational Matters

Course Duration and Course Begin | The regular study duration of the Master Course is 3 semesters (without Research Semester) or respectively 4 semesters (inlcuding Research Semester). Admission to the Master Course is possible every summer semester for the 3- and 4-semester course, and every winter semester for the 4-semester course.

Course Fee | Every semester all students have to pay the contribution fee to the students' union executive committee (AstA). Included in the contribution fee is the so called „Semester Ticket", which entitles you to use the local public transportation as well as some train connections freely. The cost for the contribution may change every semester. More information can be found at *www.fh-aachen.de/sozialbeitrag.html*

Starting in the winter semester of 2011 the Land Government North-Rhine Westphalia refrains from charging additional study fees.

Application Documents | For further information please refer to *www.fb6.fh-aachen.de/automobiltechnik/master-english/application/*

Application Deadline | Until November 30th of the previous year for the registration in summer for the 3 and 4 semester courses, until May 31st of the year for the registration in winter semester only for the 4 semester course

Any change of this date will be published in the website *www.fh-aachen.de/studierende01.html*

Modules Description and List of Lectures | As well as details about application deadline available at *www.fb6.fh-aachen.de/automobiltechnik/master-english/*

Addresses

Faculty of Aerospace Engineering
Hohenstaufenallee 6
52064 Aachen
P +49.241.6009 52410
F +49.241.6009 52680
www.fb6.fh-aachen.de

Dean
Prof. Dr.-Ing. Peter Dahmann
P +49.241.6009 52400
dekan.fb6@fh-aachen.de

Study Course Director
Prof. Dr.-Ing. Thomas Esch
P +49.241.6009 52369
esch@fh-aachen.de

Course Organizer/Advisor
Dipl.-Päd. Corinna Hornig-Flöck
P +49.241.6009 52319
floeck@fh-aachen.de

ECTS Co-ordinator
Prof. Dr.-Ing. Josef Rosenkranz
P +49.241.6009 52440
rosenkranz@fh-aachen.de

Student Advisory Service
Hohenstaufenallee 10,
52064 Aachen
P +49.241.6009 51800/51801
F +49.241.6009 1807
www.studienberatung.fh-aachen.de

Registrar's Office
Stephanstraße 58-62
52064 Aachen
P +49.241.6009 51620
www.fh-aachen.de/
studentensekretariat.html

Department of International Affairs
Hohenstaufenallee 10
52064 Aachen
P +49.241.6009 51043/51019/51018
www.aaa.fh-aachen.de

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