



# Mechatronics

## Master of Science



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*All information about the degree programme can also be found on the internet. To this end, use a suitable reader to take a photo of the QR code.*

[fhac.de/master-mechatronics/](http://fhac.de/master-mechatronics/)



# Entdecke die FH Aachen-Kollektion

[www.fhshop-aachen.de](http://www.fhshop-aachen.de)





# Introducing the Degree Programme

Mechatronics is an exciting interdisciplinary field of engineering, based on mechanical and electrical engineering, control engineering as well as signal and data processing.

Mechatronic systems sense their environment through multiple sensors, process the sensor signals and act back on the world by actuators. They can be found in almost all technological fields. Examples are current automobiles, airplanes, locomotives and train sets, smart home devices as there are washing machines or automated industrial production lines or agricultural robotic applications like ecological weed management or even wind power plant maintenance devices from the green energy sector.

Very typical for mechatronic systems is a high degree of integration of the different system components. The strong linkage between mechanical and electrical parts requires a new integrated design philosophy. It is no longer possible to develop the mechanical and electrical subsystems independently. Mechatronic system design simultaneously considers the mechanical, electrical and all other physical domains involved.

If you are a creative engineer interested in learning about the latest technology in this multidisciplinary field, have a closer look at the Mechatronics Master's degree programme at the FH Aachen.

Aachen is a lively and beautiful city with historic roots. Today it is strongly influenced by the large number of students and scientists living and working here. Its location directly at the border to the Netherlands and Belgium gives it an international flair.

Be a part of it. We are looking forward to welcoming you in Aachen.

Yours  
Prof. Dr. Klaus-Peter Kämper  
(Coordinator of the Mechatronics Master's degree programme)





## The FH Aachen and the City of Aachen – A Good Location to Start a Career

The FH Aachen University of Applied Sciences has approximately 13,000 students, 220 professors, more than 300 lecturers from industry and 600 staff members. It is one of the largest universities of applied sciences in Germany and offers degree programmes in many engineering disciplines, business studies and design.

Teaching and research at FH Aachen is very much application- and industry-oriented. We collaborate with a large number of industrial companies and R&D institutions in applied research and development projects as well as in the education of our students. For example, many thesis projects in the engineering degree programmes are carried out in close cooperation with a company or a commercial R&D institution.

The city of Aachen has approximately 250,000 inhabitants, of which more than 40,000 are students at one of the four uni-

versities in Aachen. Therefore, Aachen is very much a student city, which caters for every taste in culture, sports, pubs and restaurants.

However, Aachen is also a science and engineering city, where many small and large innovative companies operate research and development departments. Prominent names are Ford, e.Go Mobile, Ericsson, Matsushita, Mitsubishi, Talbot, Saint Gobain, Continental, Grünenthal and Aixtron. High-tech companies profit from the enormous know how in the universities and the well educated young engineers and scientists. Aachen has many historic roots from Roman times to Charlemagne. The picturesque centre around the cathedral and the town hall attracts many tourists.

Aachen is located directly at the border to the Netherlands and Belgium and is therefore a very European town. Highlights for outdoor fans are the nearby low mountain range Eifel and the moor area Hohes Venn. Fascinating towns like Cologne, Maas-tricht and Liege can be reached within an hour.





# Mechatronics

## An Interdisciplinary Approach

Product development processes in industry are rapidly changing. Products, whether consumer goods or investment goods, are getting more complex, the product life cycles are getting shorter and product development has to be performed in an interdisciplinary team in a shorter time and with a reduced budget. Smart devices have to meet the challenges of modern sustainable products.

Successful product development under these circumstances requires a team with professional skills with increasing technical depths as well as increasing technical breadth. The growing demand for interdisciplinary know how results from a clear trend towards highly integrated mechanical – electrical – electronic products, in short mechatronic products.

Mechatronic systems autonomously gather information, evaluate the data with the help of e.g. microcontrollers and carry out consequential actions. You might compare the necessary sensors (e.g. for temperature, position, pressure, acceleration or angular rate) with human senses, signal processing with the human brain and the actuators with limbs and muscles.

The additional trend towards miniaturisation furthermore enhances the need for an integrated design philosophy.

Industry therefore requires engineers with sufficient know how in both large technical fields, mechanical engineering (mechanics) and electrical engineering (electronics) to truly enable them to successfully perform integrated product development processes in a team. In addition they should have sufficient in-depth know how in one of these fields in order to be able to follow the latest technical developments and apply them in state-of-the-art mechatronic development projects.



# Competences Your New Intellectual Capital

The Mechatronics Master's degree programme imparts knowledge in mechanical engineering, electrical engineering and information technology. The focus of the degree programme is the interaction of these disciplines within mechatronic systems.

The degree programme prepares students for versatile interdisciplinary engineering functions in a broad range of industrial fields. These tasks include developing, calculating, planning, dimensioning and designing new or improved technical products. Most typically these are complex products, where mechanical and electronic functions are strongly intertwined. The field of development and design of modern automated production lines is another example where many engineering tasks require mechatronic know how.

Students acquire technical and methodical competences which enable them to recognise and analyse corresponding problems, find creative and innovative solutions and develop application ready mechatronic products. They are enabled to develop complex mechatronic systems that allow solutions which are not only faster, cheaper and smaller but although smart and sustainable. New challenges e.g. in the field of green energy and smart ecological agriculture are to be met.

Furthermore, the degree programme helps students to develop and extend their abilities to carry out and manage research and development projects in the field of mechatronics. They learn to work in international teams and gain intercultural experience.

# Career Chances Much in Demand

The ubiquitous and increasing trend towards new products with integrated mechanical and electrical functions leads to a high demand for mechatronic engineers with substantial know how in both, mechanical and electrical engineering as well as their integration.

The recent trend (Industry 4.0) towards highly automated and interconnected fabrication facilities that allows an extremely flexible and customisable production, down to a true one-piece-workflow, has furthermore increased the demand for mechatronic engineers.

Graduates of the Mechatronics Master's degree programme are provided a broad range of job opportunities. Nowadays, most of the 5000 mechanical engineering companies in Germany employ mechatronics concepts for production. Mechatronic engineers can be found in a variety of functions such as product development, production and fabrication technology, assembly automation, quality control and technical sales.

Presently, mechatronic engineers have outstanding career chances. According to all German and European industrial and engineering associations, the demand for well-educated and application-oriented mechatronic engineers will continue to steadily rise in the future. Since the expected number of graduates in this field is much lower than the industrial needs, the professional chances for mechatronic engineers are predicted to remain excellent in the years to come.



# Alumni Statements



**Harshvardhan Gupta**  
**M.Sc. Mechatronics (2014-2016)**

The Mechatronics Master's degree programme at FH Aachen is a well-balanced course with equal emphasis on theory and practice. The courses are in-line with the current industrial and academic trends and are regularly updated, which is essential in an evolving field like Mechatronics. The courses

provided me with a toolkit to understand, analyse, design and simulate mechatronic systems in a variety of domains.

During my studies, I worked as a Student Assistant (WiHi) at the Microsystems Lab at the university for 18 months, which gave me invaluable experience working in a lab environment. The skills I acquired working there still give me an edge over my colleagues.

After finishing my masters, I started my PhD at the Centre for Nano Science and Engineering (CeNSE) at the Indian Institute of Science (IISc), Bangalore. My work is in the area of MEMS design and fabrication, and the courses on Sensors and Actuators and Micro Mechatronic Systems have given me a head start in the field.

Aachen is a beautiful city with a rich heritage. With two of the top ranked universities in Germany, it has a vibrant culture with students from all over the world. Some of my most cherished memories are from my time in Aachen.



**Tushar Chaugari**  
**M.Sc. Mechatronics (2006-2008)**

The reputation of Mechatronics at FH Aachen was impressive and I really wanted to study there. Even though the course is demanding, there is a good balance between work and free time here. I also like the emphasis on practical work, which has helped me to have a better understanding of the lectures. The Faculty is welcoming and friendly, the professors and staff are always willing to help with any problems.

The course is well structured and covers the aspects of Mechatronics, which helped me pinpoint my strengths and weaknesses and further choose my area of interest. I did a 12-month student job at an European Institute last year, which has considerably improved my skills at work. This kind of experience is very important to future employers and I would definitely recommend it.

Although I come from a far away city called Pune in India, which is altogether a different city as compared to Aachen, I like it very much here since there is so much to do here and there is always something going on.

FH Aachen is a well recognised University in whole of Germany and has given me good prospects for the future. I have completed a 6-Month Internship at the German Aerospace Centre in Munich and will be continuing with my Master thesis.





## Thomas Bücker

**M.Sc. Mechatronics (2009-2011)**

I can highly recommend the Mechatronics Master's degree programme at the FH Aachen. My favourite work field is sensor and actuator technology and the classes and facilities at the Faculty of Mechatronics have been a great

place to improve my knowledge and experience. During the courses I had a lot of options to employ theoretical knowledge in practice. The laboratories in this university are well equipped and it has been never a problem to stay in the laboratories outside the class hours to use the equipment. The number of students in a batch is limited, so the studying atmosphere is very convenient. Professors have been always helpful when there were questions. I made many friends from other countries and besides the technical aspect of studying I have gained a lot of intercultural experience.

Nowadays I am a test engineer at TRW in Düsseldorf. I am responsible for the validation of automotive steering systems and my daily work is the development and implementation of diverse tests on various conditions to approve functionality and durability of the mechatronic system. The study has been a perfect preparation to the working world and I thank my fellow students and the professors for the great years of study.



## Miranda Fateri

**M.Sc. Mechatronics (2007-2010)**

I can highly recommend the Mechatronics Master's degree programme at the FH Aachen. Facilities at the Faculty of Mechatronics support to engage the theoretical knowledge with practical work. Professors and the employees have been always supportive and provided a motivated working environment, supporting individual works as well as working in a team.

FH gave me the opportunity to follow my PhD in cooperation with RWTH Aachen University. I continued my research as a post-doc at German Aerospace (DLR) in Cologne. I work intensively in cooperation between Material physics in space institute at DLR and European Astronaut Centre (EAC)- (European Space Agency (ESA)). My tasks include working on understanding behaviour of material under microgravity conditions aiming experiments on ISS. Additionally, we target using lunar the dust to develop a concept for lunar laboratories and a Moon village.



## Sandeep Unnikrishnan

**M.Sc. Mechatronics (2002-2005)**

Hello Everyone! I am Sandeep Unnikrishnan, a former MSc. Mechatronics student (2002-2005) of the University of Applied Sciences Aachen (FH Aachen). After my master studies there, I am currently working as a PhD student at the University of Twente in Enschede in the Netherlands. My present re-

search project is about Fabrication and characterization of micro fuel cells, which is directly related to my specialization subject - MEMS, during my MSc. Mechatronics degree programme. Studying at the FH Aachen was a great experience for me. The faculty and the students were very friendly and helpful. The practice oriented teaching methods followed at the FH Aachen has been very helpful for me to solve real-life engineering problems faced during my research now. The knowledge and training given by the FH Aachen staff was really helpful for my professional career. Apart from the studies and work, the nice personal and cultural experiences that I felt in Aachen are inexplicable. I am glad to have studied at FH Aachen and now to be a part of its Alumnus.



# Profile of the Degree Programme

We offer the interdisciplinary Mechatronics Master's degree programme in two different varieties. If you have a qualified Bachelor's degree in electrical engineering, mechanical engineering or a related field, you can apply for the 4-semester (i.e. 2-year) programme. If you have a qualified Bachelor's degree in mechatronics engineering with at least 210 CP, you can also apply for the shorter 3-semester (i.e. 1 ½-year) programme.

The Mechatronics Master's degree programme is a joint effort by the Faculties of Mechanical Engineering and Mechatronics (FB 8), Electrical Engineering and Information Technology (FB 5) and Aerospace Engineering (FB 6).

The continuous change of the job market for engineers and the increasing demand for engineers with an application-oriented education, which enables them to work in interdisciplinary science, led to the introduction of the Mechatronics Master's degree programme at FH Aachen in 2001. It provides a broad industrially oriented technical knowledge in mechatronic principles, components and system design.

The central idea of the degree programme is to educate highly qualified students with a first academic technical degree in a compact degree programme in order to prepare them for the manifold demands of mechatronic product development. In the first semester of the 4-semester degree programme, students are taught the fundamentals of the other discipline, which were not the central topic of their first degree, as well as fundamental control technology. In addition, students get acquainted with modern microtechnology, which is indispensable for a large share of cutting-edge sensors. In compulsory modules like Sensors & Actuators, Mechatronic System Simulation or Advanced Motion Control, students pick up the essentials of modern mechatronic systems and their components. The elective modules allow the students to acquire in depth knowledge on the application of mechatronics in certain technological fields like robotics, microsystems or automotive systems. All these modules are also aiming at enhancing the abilities of the students to perform application-oriented research and development in the area of mechatronics. An integrated R&D project in the 2<sup>nd</sup> and 3<sup>rd</sup> semester familiarises the students with

project management and working in international teams.

The students registered for the 3-semester degree programme directly start with the modules of the 2nd semester.

A strong international orientation of the degree programme results from teaching the major part of it in English. The use of the English language increases the attractiveness of this Master's degree programme for international students. At the same time, German students gain an additional international qualification by actively working with technical English, but also through intense contact with international students. In addition to the study plan, students are invited to join projects fostered by the faculty. They can participate in international and German competitions as there are COSIMA, Railway Challenge and Robotics Challenge (MBZIRC).



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A yellow car wheel is shown in motion on a dark road. Overlaid on the image is a complex fluid dynamics simulation, likely representing airflow or water flow, with swirling patterns in shades of grey and black. The simulation is most prominent around the wheel and extends across the road surface.

# Admission Requirements

**Academic entrance requirements** | Applicants for the 4-semester degree programme must have a Bachelor, Dipl.-Ing. or an equivalent academic degree in Mechanical Engineering, Electrical Engineering, Mechatronics or a related field. The Bachelor degree has to certify the completion of an at least 3-year degree programme or a minimum of 180 ECTS credits.

Applicants for the 3-semester degree programme must have a Bachelor, Dipl.-Ing., or an equivalent academic degree in Mechatronics Engineering, with a minimum of at least 210 ECTS credits.

Prospective students, who received their Bachelor degree from a university outside the European Union, have to submit their results of the GRE General test (Graduate Record Examination).

**Language requirements** | New students have to provide evidence of a good knowledge of the English language by means of the TOEFL or an equivalent English language test. Minimum TOEFL scores are 210 on the computer-based test, 79 on the internet-based test, 550 on the paper-based test. Minimum IELTS score is 6.0. Native speakers from Australia, Canada, Ireland, New Zealand, United Kingdom and the USA are exempted from proving their knowledge of English.

Applicants whose study qualification was not achieved at a German speaking university have to provide proof of basic knowledge of the German language by the "Zertifikat Deutsch" (Level B1 certificate) or an equivalent German language certificate.

**Selection of candidates** | Application for the 4-semester degree programme is only possible for the winter semester. Application deadline is May 15 each year.

Application for the 3-semester degree programme is possible for the summer semester and winter semester. Application deadline for the summer semester is February 15 each year and for the winter semester June 30 each year.

A selection committee consisting of several professors teaching in the Mechatronics Master's degree programme carefully reviews all applications and checks their qualification for this degree programme. Evaluation of the candidates' qualification is based on the results of the Bachelor degree and the GRE scores.



# Curriculum

## 4-semester degree programme

Name of Module	C/E	CR	SWS					Σ
			L	T	Lab	SU		
1 <sup>st</sup> Semester (Winter Semester)								
Fundamentals of Electrical Engineering **	C	10	4	3	0	0	7	
Fundamentals of Mechanical Engineering **	C	10	4	3	0	0	7	
Elective block 1*	E	10*						
MEMS/Microtechnology	C	5	3	1	0	0	4	
Analog and Digital Control Technology	C	8	3	1	2	0	6	
Advanced Engineering Mathematics	C	7	3	3	0	0	6	
Total		30	13	8	2	0	23	

### 2<sup>nd</sup> Semester (Summer Semester)

Systems Engineering	C	10	3	1	3	0		7
Autonomous Mobile Robotic Sytems	C	5	2	1	1	0		4
Elective block 2*	E	10*						
Mechatronics Project (Part 1)	E	4	0	0	0	2		2
Total		29	5	2	4	2		13

### 3<sup>rd</sup> Semester (Winter Semester)

Mechatronic Systems Simulation	C	10	0	0	0	6		6
Advanced Motion Control	C	5	2	1	1	0		4
Sensors and Actuators	C	6	2	1	3	0		6
Elective block 3*	E	8*						
Mechatronics Project (Part 2)	E	2	0	0	0	1		1
Total		31	4	2	4	7		17

### 4<sup>th</sup> Semester (Summer Semester)

Master's Thesis	C	27						
Colloquium	C	3						
Total		30						

\* Students with a first degree in Mechatronics have to choose elective modules with at least 28 credits in total. Students whose first degree is not in Mechatronics, have to choose elective modules with at least 18 credits in total.  
 \*\* Students with a first degree in Mechanical Engineering have to choose the module "Fundamentals of Electrical Engineering", while students with a first degree in Electrical Engineering have to take the module "Fundamentals of Mechanical Engineering". Students with a first degree in Mechatronics do not have to take any of the fundamentals courses.

The curriculum of the 3-semester degree programme is identical to the curriculum of the 4-semester degree programme without the first semester.

Name of Module	C/E	CR	SWS					Σ
			L	T	Lab	SU		
<b>Elective Modules</b>					1			
Automatisierung technischer Anlagen	E	6	2	1	1	0	4	
Elektronik für AAT	E	6	2	1	1	0	4	
Optische Nachrichtentechnik	E	6	2	1	1	0	4	
SQM - Software Qualitätsmanagement	E	6	2	1	1	0	4	
Medientechnik und Streaming	E	6	2	1	1	0	4	
Management von technischen Innovationen	E	6	2	1	1	0	4	
Rechnergestützter Regelungsentwurf	E	6	2	1	1	0	4	
Leistungselektronik für AAT	E	6	2	1	1	0	4	
Rapid Control Prototyping	E	6	2	1	1	0	4	
3D-Bildverarbeitung	E	6	2	1	0	0	4	
Advanced Control Technology	E	5	2	1	4	0	3	
Advanced CAD Methods	E	5	0	0	0	0	4	
Actuator Systems	E	5	2	2	1	0	4	
Vehicle Acoustics	E	5	2	1	1	0	4	
Advanced Automotive Electronics	E	5	2	1	1	0	4	
Design of Electronic Powertrain Management Systems	E	5	2	1	1	0	4	
General Management of Automotive Suppliers	E	5	2	1	1	0	4	
Mathematical Optimization	E	5	2	1	0	0	4	
Applied Computational Fluid Dynamics	E	5	2	1	2	0	3	
Simulation of Structures, Fields and Flows	E	8	4	0	2	0	6	
Advanced Fabrication Technologies	E	8	2	2	2	0	6	
Micromechatronic Systems	E	8	2	0	2	2	6	
Industrial Communication	E	8	2	2		0	6	
Industrielle Produktion und Industrie 4.0	E	5	0	0	0	4	4	
ROS – open source technologies in robotics	E	5	2	1	0	3	6	

The descriptions of contents of the study modules are available online.

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



# Organisational Matters

## Length of study period and commencement

The standard length of the study period for the Mechatronics Master's degree programme, including the Master project, is either 4 or 3 semesters (see p. 16). New students in the 4-semester degree programme are only admitted in the winter semester. New students in the 3-semester degree programme can be admitted in the summer semester and winter semester.

All students have to pay a contribution each semester to finance the activities of the student union and another fee to support the work of AStA (Students' Union Executive Committee). Included are the costs of the Semester Ticket, valid for all public transportation in the larger Aachen area. Fees are redetermined each semester. See [www.studierendensekretariat.fh-aachen.de](http://www.studierendensekretariat.fh-aachen.de) for details of these contributions. In 2019, they amounted to € 293.76 per semester.

## Application deadline

Applications have to be submitted via the online application portal <https://h1.fh-aachen.de/qisserver/pages/cs/sys/portal/hisinoneStartPage.faces?chco=y&noDBAction=y&init=y>.

The application deadline for the 4-semester degree programme is May 15 each year, whereas the application deadline for the 3-semester degree programme is February 15 for the summer semester and June 30 for the winter semester each year.

## Application documents

Admission regulations are given in detail on the web page of the Mechatronics Master's degree programme. See [www.fh-aachen.de](http://www.fh-aachen.de) and enter the following webcode: **11111148**

## Module description and lecture schedules

are available online at [www.campus.fh-aachen.de](http://www.campus.fh-aachen.de)

# Addresses

## Faculty of Mechanical Engineering and Mechatronics

Goethestraße 1  
52064 Aachen  
Germany  
P + 49.241.6009 52510  
F + 49.241.6009 52681  
[www.maschbau.fh-aachen.de](http://www.maschbau.fh-aachen.de)

## Dean

Prof. Dr. rer. nat. Klaus-Peter Kämper  
P + 49.241.6009 52500

## Academic Counsellor

Ms Dipl.-Ing. Gabriele Quester, M. Techn.  
P + 49.241.6009 52380  
[msc-mechatronics@fh-aachen.de](mailto:msc-mechatronics@fh-aachen.de)

## Degree Programme Coordinator

Prof. Dr. rer. nat. Klaus-Peter Kämper  
P + 49.241.6009 52500  
[kaemper@fh-aachen.de](mailto:kaemper@fh-aachen.de)

## Head of the Examination Committee

Prof. Dr.-Ing. Manfred Enning  
P + 49.241.6009 52461  
F + 49.241.6009 52681  
[vorsitz.pruefungsausschuss.fb08@fh-aachen.de](mailto:vorsitz.pruefungsausschuss.fb08@fh-aachen.de)

## General Academic Counselling

Bayernallee 9a  
52066 Aachen  
P + 49.241.6009 51800/51801  
F + 49.241.6009 1807  
[www.studienberatung.fh-aachen.de](http://www.studienberatung.fh-aachen.de)

## Registrar's Office

Bayernallee 11  
52066 Aachen  
P + 49.241.6009 51620  
[www.studierendensekretariat.fh-aachen.de](http://www.studierendensekretariat.fh-aachen.de)

## Department of International Affairs

Bayernallee 11  
52066 Aachen  
P + 49.241.6009 51043/51019/51018  
[www.aaa.fh-aachen.de](http://www.aaa.fh-aachen.de)

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