

Course Information

Master of Science Program in Mechatronics

Attention : deadline for online applications 15 April

Course homepage :
<http://www.msc.hs-weingarten.de>

Weingarten, February 2008

Table of Contents

Table of Contents	2
1. The Discipline Mechatronics	3
1.1 What is Mechatronics ?	3
1.2 Why Study the MSc in Mechatronics ?	4
1.3 Why Study Mechatronics in Weingarten ?	4
2. The Framework for the Master of Science Course in Mechatronics	5
2.1 Structure of the MSc Course.....	5
2.2 Entry Requirements and Fees.....	5
2.3 Language	6
2.4 Study Semester Abroad At One of the Partner Universities.....	6
2.5 Degree	6
3. Curriculum.....	7
3.1 Survey.....	7
3.2 First Semester MM1	7
3.3 Second Semester MM2.....	7
3.4 Third Semester MM3	7
3.5 Tables addressing the topics of the Curriculum	8
4. Example Curricula for Students from Different Disciplines	10
4.1 Typical Course Sequence for Students with a Bachelor in Mechanical Engineering	10
4.2 Typical Course Sequence for Students with a Bachelor in Electrical Engineering.....	11
4.3 Typical Course Sequence for Students with a Bachelor in Computer Science	13
5. To find out more.....	14

1 The Discipline Mechatronics

1.1 What is Mechatronics ?

Mechatronics is an interdisciplinary field in which the disciplines mechanical engineering, electrical engineering and information technology interact. While the mechanical system dominates with regard to the overall functions, the integration of digital electronics and information processing creates completely new products and functionalities as well as synergetic effects in the engineering processes. The typical example of an advanced mechatronic system is a modern automobile which contains a large network of electronic control units and embedded computer systems for a wide range of control and supervisory functions as well as improved human-machine interfaces and infotainment systems.

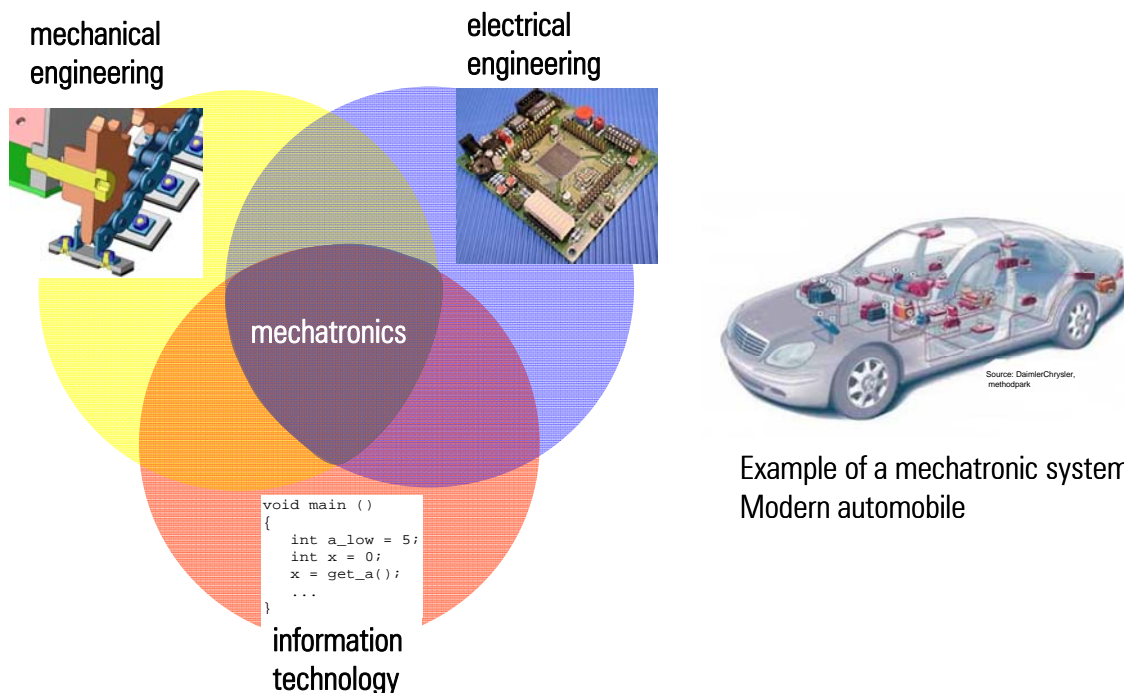


Fig. 1: Mechatronics in correlation with the traditional engineering disciplines

The progress in mechatronics is presently stimulated by

- increasing demand for intelligent automation and control,
- increasing trend towards networked systems with communicating subsystems,
- micro system technology,
- intelligent sensors and actuators,
- modern microprocessors and microcontrollers,
- software engineering technologies and
- powerful computer aided engineering tools

The potential of this future-oriented technology is documented by a rapidly increasing amount of industrial products as well as scientific conferences and journals. The worldwide and still increasing market of mechatronic systems and products comprises industries such as automotive, manufacturing, aerospace

and space industry, robotics, microsystems etc. In addition, further sub-disciplines are currently emerging like opto-mechatronics or adaptronics.

1.2 Why Study the MSc in Mechatronics ?

Solutions for complex technical problems usually require the integration of contributions from different engineering disciplines. This MSc course wants to train graduates from different engineering disciplines in the relevant complementary topics to allow them an interdisciplinary systems perspective, needed for the development of an increasing range of industrial products. Typical industrial working areas for mechatronics engineers are in research and development, production and maintenance of integrated electro-mechanical systems. Typical products like intelligent sensors, autonomous robots or precision mechanical devices are booming areas in industrial applications and raise a high industrial demand for students with a related background. Graduates of the MSc program in mechatronics improve their perspectives for jobs significantly compared to their first degree obtained, due to three key aspects :

- The curriculum extends the interdisciplinary competence by individually composed, targeted study plans, building up on a first degree in mechanical engineering, electrical engineering, computer science, ... The methodological competence in additional engineering areas, the capabilities to anticipate interdisciplinary relationships, as well as the communication competence in interdisciplinary teams qualify these students for challenging tasks in the context of complex systems and products.
- Besides an increase in technical competence, the international orientation of this program also increases the language and the intercultural expertise. In particular the medium sized regional enterprises depending on exports are looking for employees with these qualifications.
- For further advancement in the scientific area, the Master degree is acknowledged as a basis to start Ph.D. studies afterwards.

1.3 Why Study Mechatronics in Weingarten ?

The University of Applied Sciences Ravensburg-Weingarten has emphasis on application oriented education and research. This has led to well established industrial links and cooperations, as well as to several associated commercial institutions for technology transfer. The high standard of research is documented by an outstanding record of research contracts from the European Union and national research agencies.

Students enjoy the modern laboratory equipment as well as the near campus student apartments. The university is located in the very south of Germany, where Switzerland, Austria and Germany meet, in one of the most popular German areas for holidays, offering the vicinity of

- the Alps with excellent skiing facilities,
- the Bodensee (Lake of Constance), wonderful for swimming and sailing,
- historical cities, castles, churches.

In the near vicinity of Weingarten is a very high concentration of high-technology companies like EADS, MTU, ZF Friedrichshafen or Müller-Weingarten, serving the world-wide market as well as numerous medium sized enterprises in software, mechanical and electrical engineering. In this industrial environment, mechatronics raised much interest and therefore students have numerous opportunities to gain practical experience within industrial projects and cooperations. In addition, industrial scholarships

for the support of students in mechatronics and prizes for the best exams or outstanding performance are awarded.

2. The Framework for the Master of Science Course in Mechatronics

2.1 Structure of the MSc Course

The consecutive structure of the MSc in Mechatronics program is displayed in Fig. 2.

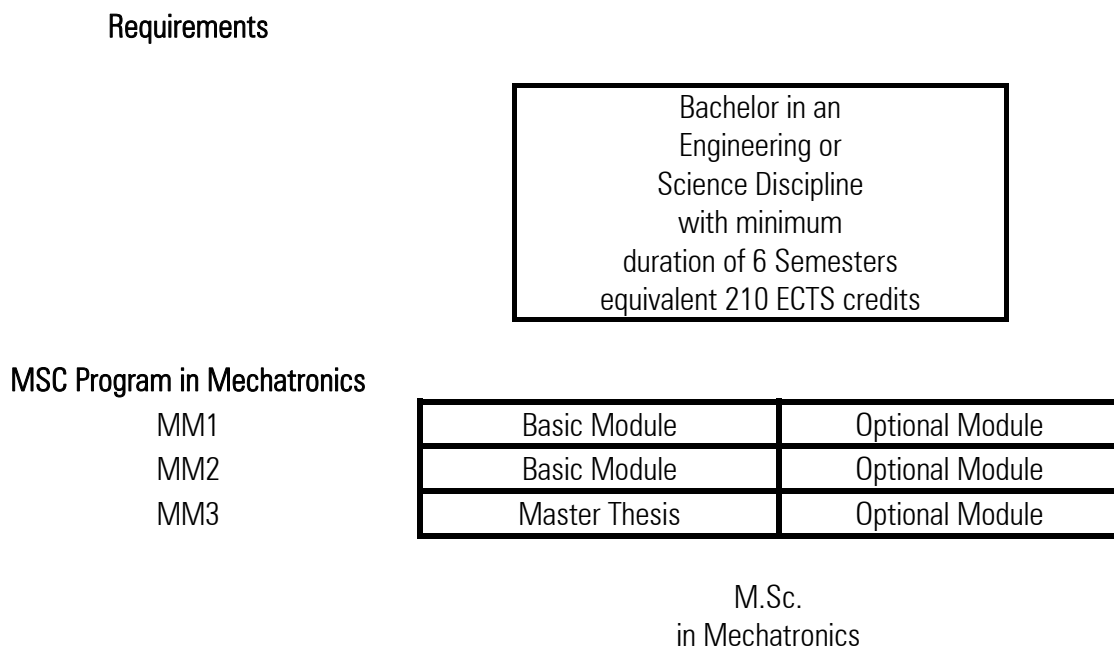


Figure 2: Structure of the Master of Science Course in Mechatronics

The three semesters of the curriculum (MM1 to MM3, duration 1.5 years) depart from a University degree regarded as equivalent or above a Bachelor's degree (for example a „Bachelor of Science in Engineering“, Dipl.-Ing.(FH) or (BA)). It need not be a Bachelor's in the discipline „Mechatronics“, but all engineering related disciplines, like mechanical engineering, electrical engineering, physics, computer science or aerospace engineering are equally suitable.

In the "basic modules" the necessary complementary subjects are defined according to previous studies. Through the "optional modules", according to his specific interests, the student can select from further topics in order to collect 30 ECTS credits (equivalent to about 24 hours of lectures per week) per semester.

2.2 Entry Requirements and Fees

- Graduate engineers with a bachelor's (BSc/B.Eng.) or a diploma in engineering or physics can apply.
- Applications have to apply online before 15th April for admission in the Winter-Semester (lectures start in October). After a pre-selection, accepted applicants are required to send in their written applications and required documents before 31 May.
- At German universities there are tuition fees of 500 € per semester.

Admission to the MSc program is decided by a selection committee composed of professors from all the different technical faculties of our university. The applicant should belong to the best 30% of his Bachelor course and should exhibit good knowledge of the English language (proven e.g. by a TOEFL-test with at least 550 points in the paperbased version). According to received application documents a ranking list is compiled by the selection committee. On average, 70% of students will not be coming from Germany. The application forms, together with copies of certificates (or supplementary advance information, if the certificate is still to be issued) and supporting documentation must reach our university by

31 May

After approval of the applications, studies will start in the following semester (lectures starting in October).

2.3 Language

The course is characterised by its compatibility with the UK/US system of studies, its given duration of 1.5 years and by the fact that English is the full course language. Therefore, all lectures, projects and presentations are presented in English as well as all documentations, reports and the Master Thesis. However, intensive German language courses are offered in addition and students also have the chance to improve their German language skills within industrial projects.

Prior to the start of lectures in October, a 4-week intensive "German for foreigners" course will be offered to all foreign students. This course should offer the students the essential background to deal with day-to-day activities, like shopping, travelling etc. Nevertheless most Germans have at least basic knowledge of English. If you are interested in participating in the language course, please tick the related point in your application form.

2.4 Study Semester Abroad At One of the Partner Universities

Beyond the technical and the language component, the MSc course should also increase the student's intercultural competence. Therefore the students with a German first degree are obliged to take the third semester MM3 at a partner university abroad. Foreign students will typically pass all three semesters at our university or can take the third semester MM3 at a partner university which is not located in their home country.

The University of Applied Sciences Ravensburg-Weingarten has emphasis on setting up a network with several well recommended international partner universities to establish a joint Master-Program in the future. Basis is the mutual recognition of complete semesters to support exchange in the final semester MM3. This could lead to the awarding of a Master's degree from both universities, the student obtaining thus certificates from two nations.

2.5 Degree

The University of Applied Sciences Ravensburg-Weingarten issues after successful completion of the three semester post-graduate course the degree „Master of Science in Mechatronics“.

3 Curriculum

3.1 Survey

In the first semester, basic courses are selected individually for each student which are complementary to their specific engineering background (e.g. mechanical engineering, electrical engineering, computer science, physics etc.) in order to generate a common basis. In the second semester, specialised topics in mechatronics like intelligent sensors and actuators, advanced control, robotics or microsystems are taught. In addition, the students have the chance to study practical aspects within labs, scientific or industrial projects. The third semester addresses the thesis and few additional specialised optional courses. It will typically be passed in one of the partner universities (in USA or Europe) abroad for German students and in Weingarten for foreign students. The student has to obtain at least 90 credits for the overall Master course, which means an average of 30 credits per each semester.

3.2 First Semester MM1

The first semester provides a „basic module“ in mechatronics by offering lecture topics which are considered as the essential basics for mechatronics (cf. Table 1 in chapter 3.5). Due to the different study backgrounds, the students will already have passed some percentage of these lectures (cf. Chapter 4 for specific curricula example for different disciplines). These earlier lectures will be acknowledged according to their technical standards, contents and duration, leading to a dispense of related lectures in individual study program. Only complementary technical topics are to be selected for the semester MM1 in the “optional module”. Thus in MM1 the main purpose of the basic module is to establish a common basis for the students with a background from different disciplines.

The students are expected to collect 30 ECTS credits (equivalent to about 24 hours per week) per semester. If the credits from the remaining complementary lectures in the basis module account for less than 30 credit points, topics from the „optional module“ are to be selected so as to ultimately achieve 30 credits.

3.3 Second Semester MM2

The second semester MM2 is split in a similar way into a basic and an optional module. But now the aim of the basic module is to address the core areas of mechatronics with specific emphasis on practical application aspects of the learned theory. In MM2, a number of 30 ECTS credits once again has to be achieved by the students.

Until the end of MM2 a specific project work (“scientific project”) comprising an effort of about 200 hours is to be performed in one of the laboratories of the university either during the lecture-free period or in parallel to the lectures. A report summarising the obtained results is to be submitted before the start of MM3. In addition, several laboratories offer the chance to learn practical aspects in the area of sensors and actuators as well as robotics.

3.4 Third Semester MM3

The third semester is to be spent in a foreign country for all students (while the Germans need to go abroad, the foreign students would typically remain at the University Ravensburg-Weingarten). The work performed abroad at approved partner universities will be credited towards the German Master's, too. MM3 is mainly determined by work for the Master thesis. In parallel, optional courses on advanced mechatronics topics can be studied.

The Master thesis must be written in English language. If the thesis work is performed at one of the partner universities, tutoring and marking are performed by one professor from University of Applied Sciences Ravensburg-Weingarten and one professor from the partner university. After completion, the results of the Master Thesis has to be presented in a public presentation at the University.

3.5 Tables addressing the topics of the Curriculum

The following tables provide an overview with regard to the courses of the “basic module” in MM1 and MM2.

Table 1: Basic Module (compulsory courses) for the first semester MM1

Courses in the Basic Module	Lecture hours per week	Credits
Basics of Electronics	4	5
Electrical Drives	4	5
Embedded Computing	4	5
Process Interface Equipment	4	5
Programming in C	4	5
Engineering Mechanics	6	7
Engineering Design and Materials	6	7
Integration of Mechatronic Systems	4	5
Simulation of Mechatronic Systems	4	5
Working in International Scientific Project Teams	-	1

Table 2: Basic Module (compulsory courses) for the second semester MM2

Courses in the Basic Module	Lecture hours per week	Credits
Laboratory on Process Interface Equipment	2	2
Scientific Project	4	5
Advanced Control	4	5
Automation	4	5
Microsystems and Materials	5	6
Robotics	4	5
Laboratory on Robotics	2	2

All subjects in the basic modules in MM1 or MM2 need either to be acknowledged from the first degree studies or need to be passed in the specific semester. These acknowledgements of previous study segments will be done by the program's study committee before the first semester starts, such that the student can plan his study activities. If necessary in rare cases, lectures from the basis module in MM1 can also be passed to MM2.

In the third semester MM3, the main focus is on the Master Thesis. In addition, optional courses from the “Optional module” can be chosen.

Table 3: Curriculum of the third semester MM3

Courses	Lecture hours per week	Credits
Optional course	4	5
Master Thesis		25

The following table 4 presents the optional courses within the “Optional Module” for MM1, MM2 or MM3:

Table 4: Courses for the Optional Module in MM1, MM2 or MM3

Optional Courses	Lecture hours per week	Credits
Industrial Project	4	5
Research Project	4	5
Artificial Intelligence	4	5
Autonomous Systems	4	5
Image Processing	4	5
International Sales	4	5
LabView	4	5
Marketing	4	5
Object Oriented Programming	4	5
Oscillatory Systems and Machine Dynamics	4	5
PLC Programming	4	5
Power Electronics	4	5
Presentation Techniques	4	5
Traffic Information Systems	4	5
Laboratory on Control	2	3
Laboratory on Automation	2	3

4. Example Curricula for Students from Different Disciplines

This chapter presents typical course sequences for students with different background as a concrete example. One professor will be associated to each student as tutor to consult him in this individual curriculum planning. Throughout the MSc program he will provide assistance in order to support a successful study completion within the given 3 semesters (1.5 years).

4.1 Typical Course Sequence for Students with a Bachelor in Mechanical Engineering

Mechanical Engineers usually have a good basis in the topics related to materials and mechanics, but they have to increase their knowledge in electronics and information processing. This is reflected in the example course plan given below.

Courses MM1	hours per week	credits
Basic Module		
Process Interface Equipment	4	5
Basics of Electronics	4	5
Embedded Computing	4	5
Simulation of Mechatronic Systems	4	5
Integration of Mechatronic Systems	4	5
Programming in C	4	5
Working in International Scientific Project Teams		1
Total Basic Module	24	31
Optional Module		
no optional course in MM1	0	0
Total Optional Module	0	0
Total MM1	24	31

Here the student got acknowledged from his Bachelor program within the basic module the courses: Engineering Mechanics, Engineering Design and Materials and Electric Drives. The student has chosen no courses within the optional module to focus on the compulsory topics in the first semester.

Courses MM2	hours per week	credits
Basic Module		
Automation	4	5
Advanced Control	4	5
Microsystems and Materials	4	5
Robotics	4	5
Laboratory on Process Interface Equipment	2	3
Laboratory on Robotics	2	3
Scientific Project	4	5
Total Basic Module	24	31
Optional Module (for example)		
International Sales	4	5
Total Optional Module	4	5
Total MM2	28	36

Here the student has chosen International Sales within the optional module to further expand his background in marketing and sales aspects.

Courses MM3	hours per week	credits
Optional Module (for example)		
Marketing	4	5
Master Thesis		25
Total MM3	4	30

Here the student again selected within the optional module a topic to further extend his business skills.

4.2 Typical Course Sequence for Students with a Bachelor in Electrical Engineering

Electrical Engineers usually have a good basis in micro-electronics and automation, but to complement their knowledge, they have to place emphasis on mechanics, construction and material related topics. A related example curriculum is given below.

Courses MM1	hours per week	credits
Basic Module		
Engineering Mechanics	6	7
Engineering Design and Materials	6	7
Integration of Mechatronic Systems	4	5
Simulation of Mechatronic Systems	4	5
Working in International Scientific Project Teams	-	1
Total Basic Module	20	25
Optional Module (for example)		
LabView	4	5
Total Optional Module	4	5
Total MM1	24	30

Here the student got acknowledged from his Bachelor program within the basic module the courses : Programming in C, Embedded Computing, Process Interface Equipment, Basics of Electronics and Electric Drives. In addition, the Laboratory on Process Interface Equipment and the course Automation of MM2 is also acknowledged. As his aim is to enter later an industrial development department, he is placing in the optional module emphasis on further research topics within an research project. This research project could also be performed in the lecture-free period. In addition, he further improves his programming skills by choosing Object Oriented Programming as optional course.

Courses MM2	hours per week	credits
Basic Module		
Advanced Control	4	5
Microsystems	4	5
Robotics	4	5
Laboratory on Robotics	2	3
Scientific Project	4	5
Total Basic Module	18	23
Optional Module (for example)		
Research Project	4	5
Object Oriented Programming	4	5
Total Optional Module	8	10
Total MM2	26	33

In the semester MM3, the student selects Artificial Intelligence as optional course to broaden his background in modern methods from computer science.

Courses MM3	hours per week	credits
Optional Module (for example)		
Artificial Intelligence	4	5
Total Optional Module	4	5
Master Thesis		25
Total MM3	4	30

4.3 Typical Course Sequence for Students with a Bachelor in Computer Science

Students of Computer Science usually exhibit good knowledge in Programming and some electronics, nevertheless details in automation and mechanics are missing.

Courses MM1	hours per week	credits
Basic Module		
Engineering Mechanics	6	7
Engineering Design and Materials	6	7
Electric Drives	4	5
Process Interface Equipment	4	5
Integration of Mechatronic Systems	4	5
Simulation of Mechatronic Systems	4	5
Working in International Scientific Project Teams	-	1
Total MM1	28	35

Here the student got acknowledged from his Bachelor program within the basic module the courses : Programming in C, Basics of Electronics and Embedded Computing. In addition, he got the course Automation acknowledged for the second semester MM2.

Courses MM2	hours per week	credits
Basic Module		
Advanced Control	4	5
Microsystems	4	5
Robotics	4	5
Laboratory Process Interface Equipment	2	3
Laboratory Robotics	2	3
Scientific Project	4	5
Total Basic Module	20	26
Optional Module (for example)		
Industrial Project	4	5
Total Optional Module	4	5
Total MM2	24	31

Here the student got no courses acknowledged from his Bachelor program within the basic module. The industrial project within the optional module has been chosen by the student in order to receive an industrial scholarship for his studies. Since the student has enough credits, he focuses on the Master Thesis in MM3.

Courses MM3	hours per week	credits
Master Thesis		25
Total MM3		25

5. To find out more

Application forms and further information are available from :

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