ETH zürich

Department of Mechanical and Process Engineering

Master Programs

D MAVT

D-MAVT's mission is to provide excellence and leadership in scientific and technical education through cutting-edge research and engineering, in order to address our most pressing social and economic challenges – both in Switzerland and worldwide. By pursing a pro-active and innovative approach to education, D-MAVT supports the development of emerging areas in engineering while maintaining a strong commitment to the fundamentals of mechanical engineering.

Whether you are planning to pursue a career in academia, in industry, or as an entrepreneur, D-MAVT's Master program will prepare you for the diverse challenges found at the frontiers of science and industrial development by exposing you to novel research, and by providing you with specialized, advanced technical training across several disciplines, including project-based coursework. By attaining a Master's degree in an engineering subject, graduates develop the following abilities:

> independent acquisition and development of knowledge;
> participation in complex decision-making processes;
> understanding, influencing and shaping long-term strategic development;
> understanding corporate, social and political environments;
> insight into the ethical aspects of the engineering profession;
> teamwork and leadership skills.

Our graduates are qualified for a variety of professional positions in industry, e.g. in research and development, production, consulting, services, management, or in any field where interdisciplinary knowledge and systems-level thinking are of prime importance.

Bachelor of Science ETH in:
Mechanical Engineering

Mechanical Engineering	ME	**D-MAVT**
Process Engineering	PE	**D-MAVT**
Micro and Nanosystems	MNS	**D-MAVT**, D-ITET
Robotics, Systems and Control	RSC	**D-MAVT**, D-ITET, D-INFK
Nuclear Engineering	NE	**D-MAVT**, EPFL
Biomedical Engineering	BME	**D-ITET**, D-MAVT, D-PHYS, D-HEST
Energy Science and Technology	EST	**D-ITET**, D-MAVT
Statistics		D-MATH, D-PHYS
Management, Technology and Economics	MTEC	D-MTEC
Neural Systems and Computation	NSC	UZH, D-ITET
Quantitative Finance		UZH, D-MATH
Computational Biology and Bioinformatics	CBB	UZH, D-INFK, D-BSSE

consecutive specialized

Curricula
D-MAVT supports a total of seven Master programs. The Masters in Mechanical Engineering (ME) and Process Engineering (PE) are consecutive programs, which follow in direct continuation from related Bachelor degrees at ETH Zurich. Our specialized Masters in Micro and Nanosystems (MNS), Robotics, Systems and Control (RSC), Biomedical Engineering (BME), and Energy Systems and Technology (EST), are interdisciplinary and offered in cooperation with other departments at ETH Zurich. Finally, the Master in Nuclear Engineering is a special program offered jointly with the Federal Institute of Technology at Lausanne (EPFL).

D-MAVT has a leading role in the administration and in the definition of the structure and rules of the Masters ME and PE as well as of the specialized Masters MNS, RSC and NE and this brochure describes mainly these Master programs.

The Master programs in ME, PE, MNS and RSC share the same structure. Students must obtain 90 ECTS to qualify for the Master degree and the programs require an average of three semesters full-time study for completion, i.e. two semesters for courses and projects, and one semester for the Master Thesis. The Master programs integrate in-depth knowledge of core areas in mechanical and process engineering with other engineering fields (electrical and computational engineering), mathematics, physics, chemistry and biology. Students develop and apply a variety of tools in order to gain a deeper understanding of the fundamental phenomena and processes that underlie these areas of study.

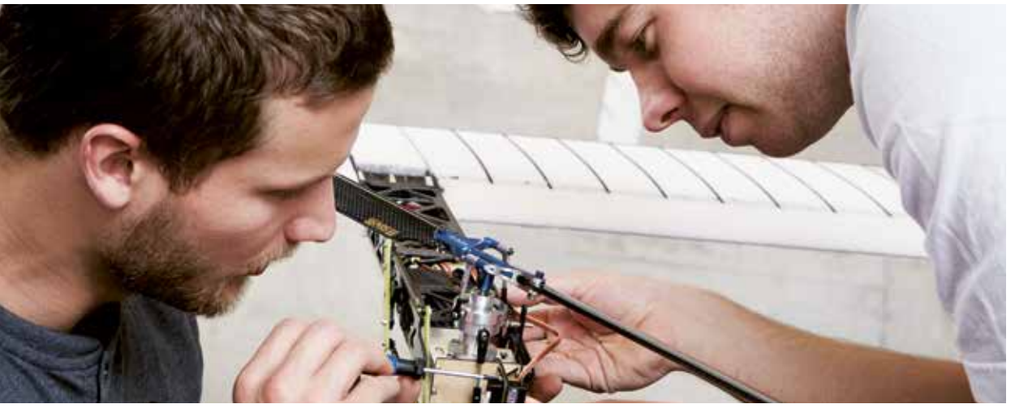
Tutor system
The Master programs in D-MAVT rely on a tutor-system, i.e. the student is personally tutored by a professor of ETH Zurich. The aim of this system is to facilitate the creation of individualized curricula and to provide one-to-one support of the students. The freedom with which many courses can be chosen allows Master students to obtain a unique, specialized education qualification, tailored to the individual's talents, expectations, personal interests and strengths.

The tutor approves the student's choices in the area of core courses, advises in the choice of the elective courses, coaches the student throughout the program, monitors progress and, if required, proposes necessary adjustments to enhance the student's performance.

Language
The teaching language is predominantly English. The course catalogue describes the contents of the lectures, exam requirements and teaching language of each course.

Application for D-MAVT Master programs
For students with an ETH Bachelor in Mechanical Engineering, admission to the consecutive Masters (ME and PE) is granted without application. All external candidates must apply at the rector's office.

For the specialized Master programs, an application is required from all candidates. Information about applications and deadlines can be found in the admissions sections of the ETH Zurich website:
www.eapply.ethz.ch →
www.master-application.ethz.ch →



Structure
The Masters curricula in ME, PE, MNS and RSC are structured in six categories, each of them contributing with different weights to the final degree. Students must obtain 90 ECTS to qualify for the Master degree and the program requires an average of 3 semesters of full-time study for completion. The structure of the Master NE requires 120 credits and has a different structure explained in the dedicated section.

Core Courses
The Core Courses lay the foundation for the Master program by providing students with core knowledge in their area of specialization. Tutors and students work together to define which courses are compulsory and which are elective for the student's individual study plan. The core courses correspond to 36 ECTS, and are usually equivalent to nine D-MAVT Master courses.

Multidisciplinary Courses
The courses in this category can be used either to add depth to scientific and technical knowledge related to the chosen specialization, or to add breadth to the range of skills in other disciplines, such as economics, management or the humanities. The Multidisciplinary Courses may be selected from the complete course catalogue of ETH Zurich, EPF Lausanne, the University of Zurich or the University of St. Gallen.

Compulsory Electives in Humanities, Social and Political Sciences
The course in Humanities, Social and Political Sciences must be selected from the course catalogue of D-GESS and enables students to perceive and analyze the societal context of their future activity as engineers, integrating scientific and technical knowledge with the corresponding social, economic, legal, political, and cultural environment.

Semester Project
The Semester Project allows students to apply technical knowledge acquired during their Master study and is aimed at training them to solve specific engineering problems under the supervision of ETH Zurich professors.

Industrial Internship
The main objective of the 12-week internship is to expose Master students to the industrial work environment. The Industrial Internship can be undertaken in a Swiss or foreign company either before starting Master studies or during the study program.

Master Thesis
The Master Thesis is a six month full-time project, where students work independently and creatively towards the solution of a research problem. The thesis is either closely related to the research activity of the tutor or an other ETH Zurich professor, or deals with a challenging industrial topic.

Semester			
1	2	3	**ECTS**
Core Courses			36
		Master Thesis	30
	Semester Project		8
Industrial Internship			8
Multidisciplinary Courses			6
Compulsory Electives in Humanities, Social and Political Sciences			2
Master of Science ETH			**90**

Master of Science in Mechanical Engineering

The consecutive program in Mechanical Engineering, offered since 2005, integrates in-depth knowledge of core areas in mechanical engineering such as mechanics, thermodynamics, fluid dynamics, materials and manufacturing science, control systems, and product development with advanced theoretical study in mathematics, computer science, physics, and chemistry. This integration is critical for multidisciplinary areas such as aerospace engineering, production systems, robotics, micro and nanotechnologies, and energy systems. Tools ranging from computer simulation and systems modeling to advanced experimental techniques are developed and applied in order to provide a deeper understanding of underlying phenomena, processes, and system characteristics in these areas.

Tutoring is undertaken by D-MAVT professors (36) and affiliated professors (9) of the department, who are committed to cutting-edge research in the following areas:
> Energy, Flows and Processes
> Mechanics, Structures and Manufacturing
> Medical Engineering
> Micro and Nanosystems and Processes
> Robotics, Systems and Control

The social context and broad interdependencies of mechanical engineering are reflected in courses in the Humanities, Social and Political Sciences. Research and innovation is stimulated by project work in which students combine theory and practice.
www.mavt.ethz.ch/education/master/mech_eng →

Master of Science in Process Engineering

The consecutive Master in Process Engineering, offered since 2005, builds on in-depth knowledge of core areas in mechanical and process engineering such as thermodynamics, fluid dynamics, mass and heat transfer, materials science, control systems, and product development.

Process engineers have a broad education, firmly rooted in the fundamentals of natural sciences and engineering that provides them with the ideal profile to play a key role in addressing issues such as new materials and production technologies, sustainable energy systems, technologies to investigate climate change, pollution prevention, and processes for the food and pharmaceutical industries.

Prospective students will have a Bachelor degree in mechanical or chemical engineering. Over the course of the Master, students develop and apply a variety of tools ranging from computer simulations and systems modeling to advanced experimental techniques in order to gain a deeper understanding of underlying phenomena, mechanisms and processes in these areas.

Tutoring is carried out by 8 professors (4 from the Institute of Process Engineering, 3 from other D-MAVT institutes and 1 from the D-BSSE), who are all committed to research in the following areas:

> Advanced Materials
> Micro- and Nano-Systems and Processes
> Particle Technology
> Separation Processes
> Sustainable Energy Systems
> Transport Processes and Reactions

www.mavt.ethz.ch/education/master/proc_eng →

Master of Science in Micro and Nanosystems

Micro and nanosystems products are becoming increasingly interdisciplinary and complex, involving key technologies from across multiple engineering disciplines. Processes and methods from engineering sciences, physics and mathematics can therefore be used to work on important issues in the exploration and development of new integrated systems and respective innovations. Companies that utilize technology and system integration require a new generation of engineers who are familiar with a broad range of natural and engineering sciences. These engineers must create and drive innovation for new business opportunities.

The specialized Master program in Micro and Nanosystems, offered by D-MAVT and D-ITET since 2006, is a future-oriented education aimed at outstanding Bachelor graduates from all over the world. The backbone of the curriculum consists of core courses requiring interdisciplinary coursework.

The program concentrates on the synthesis of aspects from electrical and mechanical engineering, physics, biology and process engineering. Specifically, it is focused on basic theory, fundamental methodology and application-specific aspects of materials and their properties, quantum mechanics, the novel properties of devices, system integration, modeling and simulation. Tools and techniques range from computer simulation to advanced experimental techniques in design, function and system integration, manufacturing, and characterization. Elective courses in product development and innovation management provide the knowledge needed to create marketable and innovative products.

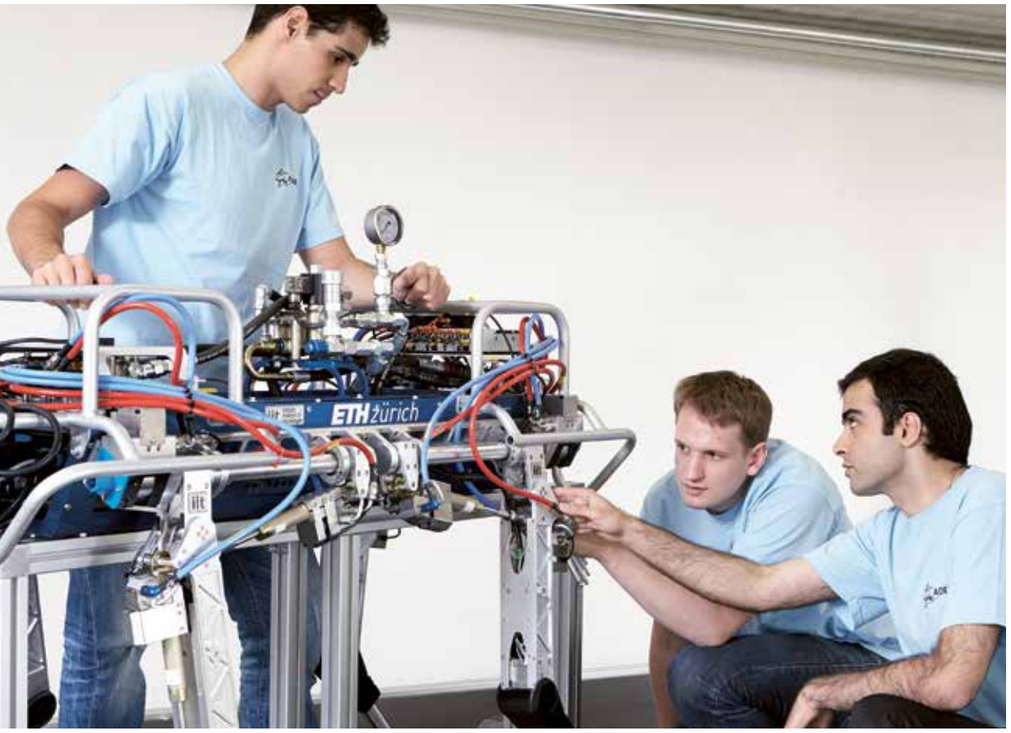
Students also address the social contexts in which micro- and nanosystems engineering is applied, and the field's broad interdependencies, through courses in the Humanities, Social and Political Sciences.

The program provides theoretical fundamental and interdisciplinary education in:

> Devices and Systems
> Energy Conversion and Quantum Phenomena
> Material Surfaces and Properties
> Modeling and Simulation
> Laboratory courses

The program is tailored to the individual needs of students. Faculty members from different departments including D-MAVT (9), D-ITET (4), D-PHYS (2) and D-BSSE (1) serve as tutors and are committed to providing a cutting-edge research and teaching environment with strong international exposure.

www.mastermicronano.ethz.ch →



Master of Science in Robotics, Systems and Control

Products and systems are more complex than ever and require an integration of technologies from all engineering science disciplines. In response to this trend, ETH Zurich has recruited a number of top professors from around the world to create a leading center in the field of robotics, systems and control.

The Master in RSC, offered jointly by D-MAVT, D-INFK D-ITET and D-HEST, is a specialized program open to students seeking an outstanding education at the interface between mechanical and electrical engineering and computer science. Bridging the gaps between these disciplines, the program offers students a unique learning environment and a multi-disciplinary education that will enable them to develop innovative and intelligent products and systems in the service of today's most pressing challenges: energy supply, environment, health care and mobility.

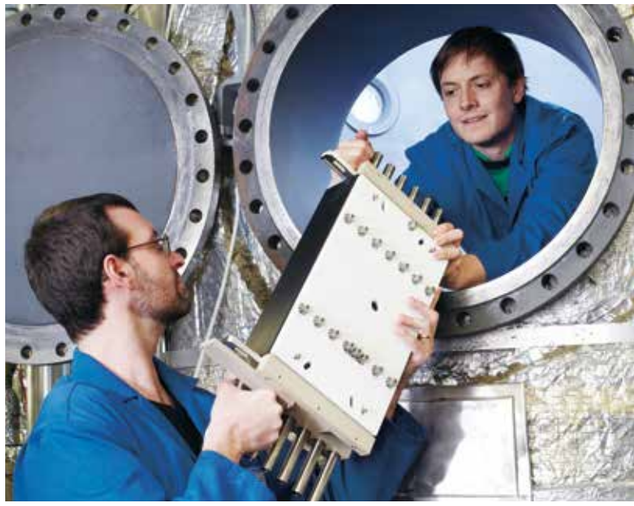
Research in RSC poses fundamental questions about the design, physical modeling, and control of complex and highly interactive systems. Furthermore, it deals with the principles of perception that enable robotic systems to see, analyze and develop rational responses to their environments and choose appropriate actions in relation to a given goal. Specific research activities range from fundamental theory in modeling and control to challenging applications in bio-medical and rehabilitation engineering, power systems, automobiles and aircraft, space robots, air traffic management, home robots, micro- and nano-robots, and more.

These exciting research efforts transcend traditional boundaries and require engineers with interdisciplinary backgrounds and skills. The Master in RSC therefore provides students with a theoretical and application-driven education in the following areas:

> Robot Design, Modeling and Control
> Systems Engineering
> Physical Modeling and Simulation
> Optimization and Control
> Perception, Graphics, Virtual Reality
> Navigation and Path Planning
> Embedded and Distributed Computing
> Artificial Intelligence

www.master-robotics.ethz.ch →

Master of Science in Nuclear Engineering



Nuclear technology, particularly the generation of energy via nuclear fission, is a high-tech sector which involves extremely high levels of refinement of the raw material natural uranium. The entire energy generation chain is highly complex, not least because of the comprehensive safety technology and safety culture it entails. The result is a high level of interdisciplinarity, ranging from nuclear, neutron and reactor physics and radiation protection to thermo-fluid dynamics, reactor safety and materials science.

D-MAVT in conjunction with the EPF Lausanne (Section of Physics), has offered the Master program in Nuclear Engineering since 2008. The program prepares students for the diversity found at the frontiers of research and industrial development in the field of nuclear technology. The tasks facing young researchers today include, among others, the safe, reliable operation of existing and new nuclear reactors, the sustainable supply of nuclear fuel, closure of the fuel cycle, and the disposal of radioactive waste without harm to the environment.

The objectives of the program are to:

> provide in-depth knowledge of the fundamental science and technology required to harness nuclear fission for energy supply;
> present the basic principles and challenges of controlled nuclear fusion;
> provide knowledge of nuclear techniques in medicine and industry;
> provide a view of the complete nuclear energy conversion system and the entire fuel cycle from uranium mining to the back-end;
> offer the background necessary to integrate nuclear energy into energy systems as a whole.

The Master in Nuclear Engineering requires 120 credits, obtained over the course of four semesters. The first semester of the Master takes place at EPF Lausanne, the second semester at ETH Zurich; in the third semester the courses are organized as lecture blocks at Paul Scherrer Institute, which contributes to the program.

The compulsory courses are designed specifically for the students of the Master program NE while elective courses are selected from the other Master programs at ETH Zurich and EPF Lausanne.

Graduates with a Master degree in Nuclear Engineering are qualified experts in the strongly interdisciplinary field of nuclear energy production. Graduates are equipped with substantial knowledge in fusion technology and/or non-power-producing applications of nuclear techniques. They are versed in research methods, capable of conducting specific R&D projects and are prepared for a wide spectrum of professional roles related to the operation and surveillance of nuclear power plants. Due to the interdisciplinary character of the program, graduates are also well-equipped for work in other fields of energy conversion technology.

www.master-nuclear.ch →

Semester				
1	2	3	4	ECTS
Compulsory Core Courses				32
Elective Core Courses				30
			Master Thesis	30
Free Elective Courses				10
		Semester Project		8
		Industrial Internship		8
Entrepreneurship and Technology Management				2
Master of Science in Nuclear Engineering, ETH Zürich – EPF Lausanne				**120**

Students with a Bachelor in Mechanical Engineering have access to other Master programs at ETH Zurich.
D-MAVT is involved directly in the following two specialized Master programs, with D-ITET as leading house.

Master in Biomedical Engineering
The specialized Master program in Biomedical Engineering has been created to meet the growing need for interdisciplinary scientists trained to work at the interface between biology, medicine and engineering. ETH Zurich and the University Hospital of Zurich provide a fertile ground for innovative biomedical engineering research and have created numerous biotech spin-offs and several interdisciplinary academic programs. BME is a joint program of four ETH Departments – D-ITET, D-MAVT, D-HEST and D-PHYS – but draws its curricula from no less than eight different departments and provides individually tailored training in one of five tracks within biomedical engineering: Bioelectronics, Bioimaging, Biomechanics, Medical Physics, and Molecular Bioengineering.
www.master-biomed.ethz.ch →

Master of Energy Science and Technology
Clean, affordable and reliably-available energy is of paramount importance for the well-being of industrialized economies and the development of emerging countries. Developing future sustainable energy systems requires research and education in a large number of scientific disciplines. For this purpose, the specialized EST Master program on energy topics is jointly offered by D-ITET and D-MAVT with the participation of D-MTEC and other ETH Zurich Departments.
www.master-energy.ethz.ch →

With a Bachelor degree in Mechanical Engineering it is also possible to access other Master programs offered at ETH Zurich, in which the Department is not an active partner:

> Management, Technology and Economics:
www.mtec.ethz.ch/education/msc_mtec →
> Neural Systems and Computation:
www.nsc.uzh.ch →
> Quantitative Finance:
www.msfinance.ethz.ch →
> Statistics:
www.masterinstatistics.ethz.ch →

The Department

The Department of Mechanical and Process Engineering (D-MAVT) at ETH Zurich is recognized as a center of excellence throughout the world. Research undertaken by W.C. Röntgen (Nobel Prize), H. Rohrer (Nobel Prize), A. Stodola and J. Ackeret exemplifies the landmark innovations achieved at D-MAVT.

The Department's dynamism and flexibility continue to attract top-ranking students and scientists from all over the world. With a base of over 2700 high-performing students and engineers, D-MAVT is the largest department at ETH Zurich in terms of student numbers. We also form a key link between the ETH Zurich and Swiss and global industry, by training future scientists and engineers, launching new spin-off companies, and maintaining strong collaborations with our industrial partners.
www.mavt.ethz.ch →

Figures in 2013
> 400 Bachelor freshmen
> 1500 Bachelor students
> 700 Master students
> 400 Doctoral students
~ 50 Exchange students
~ 600 Staff members
36 Professors

Contact
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Department of Mechanical and Process Engineering
info@mavt.ethz.ch
www.mavt.ethz.ch /education →

ETH Zurich

ETH Zurich has come to symbolise excellent education, ground-breaking basic research and applied results that are beneficial for society as a whole. Founded in 1855, it today offers researchers an inspiring environment and students a comprehensive education as one of the leading international universities for technology and the natural sciences. ETH Zurich regularly appears at the top of international rankings as one of the best universities in the world.

ETH Zurich today has about 18,000 students from over 100 different countries, 3,800 of whom are doctoral students. More than 400 professors teach and conduct research in the areas of engineering, architecture, mathematics, natural sciences, system-oriented sciences, and management and social sciences. It offers researchers an inspiring working environment and its students a comprehensive education. 21 Nobel Laureates have studied, taught or conducted research at ETH Zurich, underlining the excellent reputation of the institute.
www.ethz.ch →

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