MSc ETH in Micro and Nanosystems
An educational program that can cope with the challenges of a fast changing industrial and academic environment

Jointly offered by D-MAVT and D-ITET
The world of MEMS
Micro and nanosystems are all around us

- thermoelectric heat flux
- silicon microphone
- Seebeck effect
- environment
- entertainment
- infrared camera
- gyroscope
- dew point
- thermopile
- accelerometer
- capacitors
- digital micromirror device
- bolometer
- energy harvester
- humidity sensor
- ultrasound
- healthcare

world of mems

consumer electronics
automotive industry
internet of things
robotics

The world of MEMS
Micro and nanosystems are all around us
The world of MEMS
Micro and nanosystems are all around us
**The world of MEMS**

**MEMS in healthcare -- Wearable Electronics**

**Smart watches** and smart wrist bands keep track of our activities and can monitor physiological and environmental properties.

**Accelerometers** can track the physical motion vibrations during optical pulse measurements and improve signal reading.
The world of MEMS
Micro and nanosystems are all around us
The world of MEMS

MEMS in robotics – Heat flux sensors

Robotic laser welding enables joining an extended range of materials with high quality and low weld footprint.

Thermoelectric heat flux sensors measure laser power, enabling more reliable operation.

greenTEG gRAY Laser Power Detector Series
The world of MEMS
Micro and nanosystems are all around us
The world of MEMS

MEMS in automotive industry - Gyroscope

Micromachined gyroscopes and accelerometers are key elements in airbag control systems.

Airbag control systems combine multiple sensor devices to predict accidents and significantly increase passenger safety.
Autonomous driving requires exact determination of the vehicle’s motion parameters and its environment to allow accident-free driving.

Utilized MEMS sensors include: accelerometer, gyroscope, laser radar, ultrasound positioning, etc.
The world of MEMS
Micro and nanosystems are all around us

thermoelectric heat flux
Seebeck effect
silicon microphone
environment

consumer electronics
automotive industry
internet of things

thermoelectric generator
altimeter
dew point
gyroscope

robotics
capacitor
healthcare

humidity sensor
ultrasound

The world of MEMS
Micro and nanosystems are all around us

thermoelectric heat flux
Seebeck effect
silicon microphone
environment

consumer electronics
automotive industry
internet of things

thermoelectric generator
altimeter
dew point
gyroscope

robotics
capacitor
healthcare

humidity sensor
ultrasound
The world of MEMS

MEMS & Internet of Things – Humidity sensor

The Internet of Things is a network of physical devices that operate within the existing internet infrastructure.

Environmental monitoring devices can sense air quality, temperature, humidity, noise, light, pressure, etc.

https://cubesensors.com/
The Case for a Specialized Master in Micro and Nanosystems

- Be prepared for the ever-changing academic and industrial landscape by an **inter-disciplinary education**.
- Have access to a broad and interconnected spectrum of research areas.
- **Study among other highly qualified students with similar interests and varying backgrounds**
• Welcome day and apéros with tutors and other MNS students

• Talks with PhDs and start ups

• Social events for future, current and former MNS students

• Contact: Leon Stolpmann  
  leons@student.ethz.ch

mns@amiv.ethz.ch  
https://www.facebook.com/MNSETHZ
International Contest of Applications in Nano-Micro Technologies (iCAN)

2015
Alaska boots

2014
Post disaster monitoring system

2nd Place in Sendai, Japan

2nd Place, Swiss competition

www.ican-contest.ch

2016
µWINDfon

1st prize in Paris, France
Excursions

• 2011 Siemens Mobility, Zürich
• 2011, 2015, 2018 Sensirion, Stäffa
• 2012 Kistler, Winterthur
• 2013 ABB, Lenzburg
• 2014 Siemens Building Technologies, Zug
• 2016 Sonova (Phonak), Stäffa
• 2017 IST AG, Ebnat-Kappel
Industry Support for the Master in Micro and Nanosystems

Companies supporting the master program:

- ABB
- greenTEG
- IBM
- Kistler
- Bosch
- Siemens
- Novartis
- Sensirion

Binnig and Rohrer Nanotechnology Center, the new nanoscience center of IBM and ETH Zurich.
> 200 companies and institutes in CH, A, F, D are working on/with micro and nanosystems

The Case for a Specialized Master in Micro and Nanosystems

• Be prepared for the ever-changing academic and industrial landscape by an inter-disciplinary education.

• Have access to a broad and interconnected spectrum of research areas.

• Study among other highly qualified students with similar interests and varying backgrounds

• Set yourself apart by a further and specialized education:
  ➢ Transdisciplinary education, team oriented
  ➢ Modern technology for innovations
  ➢ System integration and applications
### Overview of Master categories structure

<table>
<thead>
<tr>
<th>Category</th>
<th>CP</th>
<th>Description</th>
</tr>
</thead>
</table>
| Core Courses                    | 36 | • Basis of the Master's Program  
• Providing core knowledge in the respective area of specialization  
• Choice of courses in accordance with tutor |
| Multidisciplinary Courses       | 6  | • Courses at ETH, Uni Zürich and HSG  
• Choice of courses in accordance with tutor |
| „GESS Science in Perspective“  | 2  | • General-education courses in humanities, social and political science from the course catalogue of D-GESS ETH Zürich |
| Semester Project                | 8  | • Use of acquired technical knowledge  
• Provides experience in solving a specific engineering problem |
| Industrial Internship           | 8  | • Min. 12-week internship in a Swiss or foreign company |
| Master’s Thesis                 | 30 | • Conclusion of the Master’s Program  
• Independent and scientific work |

http://www.mastermicronano.ethz.ch/
Each tutor has particular areas of interest and offers every student an individualized curriculum within the relevant research area from the list of
- recommended core courses and
- elective core courses
Master Thesis (30 ECTS)

- ~ 6 months full-time work
- Subject with project plan
- Approved by the tutor
- Project at ETH and/or abroad

Before starting thesis work, students must
- have fulfilled all specific admission requirements;
- have achieved 32 credit points in the category core courses;
- have acquired the credit points corresponding to the Semester Project (8 cp)
Application for HS2019

- Application period: **01 March – 31 March 2019**


- No need of recommendation letters for ETH Bachelor students

- No need of English test for ETH Bachelor students

- For questions regarding the admission process: ETH Admission Office: **master@ethz.ch**
D-MAVT Studienadministration

ETH Zentrum
LEE K 208
Leonhardstrasse 21
8092 Zürich

info@mavt.ethz.ch

Opening Hours during the semester:
Monday: 13:00 - 16:00
Tuesday: 09:00 - 13:00
Wednesday: 09:00 - 12:00
Thursday: 13:00 - 16:00
Friday: 09:00 - 12:00

Daniela Divljak
Lorena Luzi
Tsamcho Meier
Dr. Maddalena Velonà
The Master program is tutor-driven

Each student is entitled to a tutor

Tutor and student define an individualized curriculum

Tutor coaches students in course planning, research, mobility, industrial training and monitors progress

Changing the tutor is possible
Tutors in Micro and Nanosystems

- D-MAVT
  - Jürg Dual
  - Christofer Hierold
  - Dennis Kochmann
  - Brad Nelson
  - David Norris
  - Dimos Poulikakos
  - Sotiris Pratsinis
  - Mark Tibbitt
- D-ITET
  - Jürg Leuthold
  - Janos Vörös
  - Vanessa Wood
- D-PHYS
  - Klaus Ensslin
  - Thomas Ihn
- D-BSSE
  - Andreas Hierlemann
Learning Agreement

Prepare your Learning Agreement on the basis of your interests and the tutor’s sample curriculum

- Submission: Within 3 weeks of the start of the semester
- Study Plan: For each semester or for the whole study program
- Updates: Always possible with tutor’s approval
- Final version: Before starting the Master’s Thesis
Prof. Mark Tibbitt
D-MAVT, Macromolecular Engineering Laboratory

Main Research Interests:
- Soft materials design with a focus on biomedical applications
- Additive manufacturing of multicomponent biomaterials
- Injectable drug delivery systems
Prof. Christofer Hierold
D-MAVT, Micro and Nanosystems

Main Research Interests:
- Advanced microsystems:
  e.g. thermoelectric generators, acoustic sensors, and microsystems for medical applications
- Nanotransducers and nanosensors:
  e.g. ultra low power carbon based sensors

www.micro.mavt.ethz.ch
Prof. Jürg Leuthold
D-ITET, Institute of Electromagnetic Fields (IEF)

Main Research Interests:
Design – Fabrication – System-level testing
- Optoelectronic devices for communications
- Sources and detectors for sensing
- Plasmonic devices

100 Gbit/s plasmonic transmitter.
Wireless antenna using nanotechnological devices
Novel nonlinear light sources

www.ief.ethz.ch
Prof. Brad Nelson
D-MAVT, Institute of Robotics and Intelligent Systems

Main Research Interests:
- Making sub-mm intelligent machines
- Manipulating sub-mm scale objects

www.iris.mavt.ethz.ch
Fundamentals (Prof. Mavrantzas, Goudeli, Kelesidis)

Catalysis (Dr. Büchel, Koirala, Fujiwara)

Biomaterials (Dr. Sotiriou, Spyrogianni, Blattmann, Starsich)

Devices (Güntner, Schädli)

www.ptl.mavt.ethz.ch
Main Research Interests:
- Stretchable bioelectronic devices
- Biosensors
- Interfacing biology with FluidFM nanopipette
- Building controlled neuron networks
Prof. Jürg Dual
D-MAVT, Institute of Mechanical Systems

Main Research Interests:
- Ultrasonic Particle Manipulation
- Wave Propagation in Microsystems
- Fluid Sensing in Microsystems

www.zfm.mavt.ethz.ch
Main Research Interests:

- modeling across length and time scales: bridging from atoms to devices
- engineered (meta)materials with controllable properties
- materials by design: linking microstructure to properties
Prof. Dimos Poulakakos
D-MAVT, Laboratory of Thermodynamics in Emerging Technologies

Main Research Interests:
- Energy conversion, transport and fluidics
- Biothermofluidics
- Energy and the environment

www.ltnt.mavt.ethz.ch
Prof. Andreas Hierlemann
D-BSSE, Bio Engineering Laboratory

Main Research Interests:
- Neuroelectronic interfacing
- Microfluidics and microtissues
Prof. David Norris
D-MAVT, Optical Materials Engineering Laboratory

Main Research Interests:
- Synthesis/characterization of quantum dots
- Thermal plasmonics for thermophotovoltaics
- Quantum plasmonics

www.omel.mavt.ethz.ch
Prof. Vanessa Wood
D-ITET, Laboratory for Nanoelectronics

Main Research Interests:
- Optical and electronic measurement techniques on nano- and micro-size materials & structures
- Nano- and micron-size materials with new electronic or ionic properties
- Applications: LEDs, solar cells, batteries

Materials

Devices

Analytics

www.lne.ethz.ch
Prof. Klaus Ensslin
D-PHYS, Nanophysics

Main Research Interests:
- Nanostructures of GaAs family and Graphene
- Superconductor/Semiconductor hybrids
- Transport in mesoscopic structures

www.nanophys.ethz.ch
Prof. Thomas Ihn
D-PHYS, Nanophysics

Main Research Interests:
• Low-temperature transport experiments
• Graphene and vdW-heterostructures
• III-V semiconductor nanostructures
• Quantum dot qubits coupled to single photons
• Scanning probe techniques applied to semiconductor nanostructures
For more information, contact us or visit:

http://www.mastermicronano.ethz.ch/