Mechanical Engineering
Master @

EPFL
A. Master degree @EPFL
B. Orientations/specializations
C. Where to find SGM information ?
D. Specific information : specializations, minor, Project et SHS
E. Professors and laboratories
A. Master degree @EPFL

Contact:

Director
Pr. François Gallaire

Deputy
Dr Alain Prenleloup

Secretary
Mme Anne Legrand

Apprentice
Mme Fatoux Katelyne
Contact:

- Reception hours:
  10h – 12h Monday to Friday

- By appointment or by email:
  sgm@epfl.ch
A. Master degree @EPFL

Neuchâtel

EPFL worldwide

Lausanne

Sion
The EPFL should be a model university in terms of:

- Its culture of respect, tolerance and integrity
- The rich variety of para-academic activities
Let's set the example of a culture of respect

- Harassment, violence and discrimination are not tolerated here
- Provide and seek support
- Talk about it, bring up the problems

> go.epfl.ch/tns (Trust and Support Network)
> Take the online training on Moodle: « Promoting Respect »
A. Master degree @EPFL

Statistic: students - teachers
European Credit Transfer and Accumulation System: 1 ECTS = 30 work hours
(60 ECTS per year x 30 work hours / 45 work weeks = 40 hours by weeks)
### A. Master degree @EPFL

#### MSc curriculum (120 ECTS)

<table>
<thead>
<tr>
<th>Course / Project</th>
<th>ECTS</th>
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<tbody>
<tr>
<td><strong>Electives in Mechanical Engineering</strong></td>
<td></td>
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<tr>
<td>Specialization : ≥ 30 ECTS</td>
<td>≥44</td>
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<tr>
<td>(Excel form on sgm.epfl.ch)</td>
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<tr>
<td><strong>Other electives / Minor</strong></td>
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<td></td>
<td>≥30</td>
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<tr>
<td><strong>1 Semester Project in Mechanical Engineering</strong></td>
<td>10</td>
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<tr>
<td><strong>SHS Course + Project</strong></td>
<td>6</td>
</tr>
<tr>
<td><strong>Internship and Master Project in Mechanical Engineering</strong></td>
<td>30</td>
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</tbody>
</table>

European Credit Transfer and Accumulation System: 1 ECTS = 30 hours of work

(60 ECTS per year x 30 working hours / 45 working weeks = 40 hours per week)
### B. Orientations/specializations

<table>
<thead>
<tr>
<th>Fluid mechanics</th>
<th>Mechanics of solids and structures</th>
<th>Control and mechatronic</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Fluid mechanics images" /></td>
<td><img src="image2.png" alt="Mechanics of solids and structures images" /></td>
<td><img src="image3.png" alt="Control and mechatronic images" /></td>
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<thead>
<tr>
<th>Energy and thermal science</th>
<th>Design and manufacturing</th>
<th>Biomechanics</th>
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<td><img src="image4.png" alt="Energy and thermal science images" /></td>
<td><img src="image5.png" alt="Design and manufacturing images" /></td>
<td><img src="image6.png" alt="Biomechanics images" /></td>
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</table>
## B. Filières et spécialisations

### Mécanique des fluides
- Drainage of gaseous and liquid fluids
- Non-Newtonian fluid
- Multi-phase flow
- Fluid-structure interaction
- Energy
- Bioengineering application
- Transport

### Mécanique des solides et des structures
- Transport
- Aerospace
- Power generation
- Sports Technology
- Biomedical applications
- Materials Technology
- Design method

### Contrôle et mécatronique
- Control: design of control systems to ensure stability and performance
- Mechatronics: electromechanical integration of controlled systems

### Science thermique et énergie
- Building and industry
- Transport
- Electricity generation
- Renewable Energy
- Etc.

### Conception et production
- Design process
- Modeling
- Experimental Setup
- Design optimization
- Product Manufacturing

### Biomécanique
- Applied: design of orthopedic or cardiovascular implants
- Fundamental: correlation between biological response and predictive simulations
B. Orientations/specializations

Control and mechatronic

Pr Alireza Karimi
B. Orientations/specializations

Biomechanics

Pr. Salman Sakar
B. Orientations/specializations

Mechanics of solids and structures

Pr. Guillermo Villanueva
B. Orientations/specializations

Design and manufacturing

Pr. Jürg Schiffmann
B. Orientations/specializations

Energy and thermal science

Pr. Giulia Tagliabue
B. Orientations/specializations

Fluid mechanics

Pr. Tobias Schneider
C. Where to find SGM information?

IGM general webpage: https://sti.epfl.ch/fr/recherche/instituts/igm/

sgm@epfl.ch
C. Where to find SGM information?

Orientation: https://sti.epfl.ch/fr/recherche/instituts/igm/

[…] enseignement/master-en-genie-mecanique/filieres-sgm/
C. Where to find SGM information?

Usefull documents: [https://sti.epfl.ch/fr/recherche/instituts/igm/documents-utiles/](https://sti.epfl.ch/fr/recherche/instituts/igm/documents-utiles/)
16.09.2022

**44+ ECTS**
From the list on the 2nd sheet + 2 Bachelor courses (to be approved by Section Director)

**16 ECTS**
Semester project + SHS

**30+ ECTS**
Minor or any courses including those from the list on the 2nd sheet

Concentration: not mandatory!

Concentration advisor’s signature: needed only if you do a concentration

Becomes green if your plan complies with the rules

Suggested workload 25-35 ECTS / semester
Already proposed by IS-Academia in the Groupe « Options »

To be looked up and placed in the Groupe « Options »
C. Where to find SGM information?

What are the learning prerequisites?

Advanced control systems

ME-524
Enseignant(s) : Karem Akrea
Langue: Anglais
Withdrawal: It is not allowed to withdraw from this subject after the registration deadline.

Summary
This course covers some theoretical and practical aspects of robust and adaptive control. Robust controller design with H-\infty performance, digital controller design with pole placement technique, direct and indirect switching adaptive control are studied and implemented in a hands-on lab.

Content
Stability, performance and robustness of closed-loop control systems. Robust controller design by loop-shaping. Robust H-\infty-hypothesis controller design in the frequency domain. Multivariable decoupling controller design.

Two-degree of freedom RST, digital polynomial controller. Pole placement technique and its relation to Internal Model Control (IMC), Model Reference Control (MRC) and Minimum Variance Control (MVC). Robust pole-placement with G-parameterization. Parameter adaptation algorithms. Direct and indirect adaptive control. Switching adaptive control.

Keywords
Adaptive control, robust control, digital RST controller.

Learning Prerequisites

Required courses
Control systems + Lab

Recommended courses
1. Control Systems
2. System Identification
3. Multivariable systems

Important concepts to start the course
- Analyze a linear dynamical system (both time and frequency responses)
- Represent a linear system by a transfer function
- Identify a dynamic system using experimental data
- Design a PID controller
- Design a sample controller for a dynamic system

Learning Outcomes
By the end of the course, the student must be able to:
- Design an advanced controller for a dynamic system, A11
- Assess / Evaluate the stability, performance and robustness of a closed-loop system, A12
- Define (specifications) the adequate control performance for dynamic systems, A13
- Propose several control solutions, formulate the trade-offs, choose the options, A14

SEMÁINE DE RÉFÉRENCE

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LEGÈNDE
- [ ] Cours
- [ ] Exercice, TP
- [ ] Projet, autre

Learning Prerequisites

Required courses
Control systems + Lab

Recommended courses
1. Control Systems
2. System Identification
3. Multivariable systems

Important concepts to start the course
- Analyze a linear dynamical system (both time and frequency responses)
- Represent a linear system by a transfer function
- Identify a dynamic system using experimental data
- Design a PID controller
- Design a sample controller for a dynamic system
D. Specific information

How to choose and register for courses?

1. Create your study plan for the 3 semesters (Excel form)
2. If you do a specialization: submit it for approval to the concentration advisor and then to SGM secretariat
3. A course can count once either in a Minor or in Groupe « options »
4. Register for courses in IS-Academia (mandatory) before October 1st
5. Announce all major modification (ex: minor surrender) of your study plan to our secretariat (update and submit your form)
6. Exam withdraw until the 10th week’s semester, except for semester courses (November 26)
7. 2 Bachelor courses may eventually be accepted with the section’s Director prior agreement
General exam withdrawal deadline for 2022-23 Winter Session: 25 November 2022

It is not possible to withdraw after 30th September from the semester courses listed here:

- ME-437先进固体力学
- ME-403应用机械设计
- ME-482生物力学的肌肉骨骼系统
- ME-414计算多尺度建模固体
- ME-498持续改进制造系统
- ME-428数据驱动设计与制造方法
- ME-412实验方法在工程力学
- ME-516产品系统生命周期性能
- ME-410机械产品设计与开发
- ME-480机理生物学：如何调节生命
General exam withdrawal deadline for 2022-23 Winter Session: 25 November 2022

It is not possible to withdraw after 30\textsuperscript{th} September from the semester courses listed here:

- ME-469 Nano-scale heat transfer
- ME-474 Numerical flow simulation
- ME-419 Production management
- ME-424 Systèmes mécatroniques
- ME-467 Turbulence
- MICRO-413 Advanced additive manufacturing technologies
- ENV-542 Advanced satellite positioning
- MICRO-421 Imaging optics
- MGT-555 Innovation & entrepreneurship in engineering
- MICRO-401 Machine learning programming
- MSE-351 Surface analysis
Art. 12 - Choix des branches

(5) L’étudiant est responsable de la conformité au règlement du choix des branches

Art. 12 al. 5 (english)

It is the student’s responsibility to have a study plan that complies with the section rules
D. Specific information

Minors: subscription before the end of the first semester

Recommended Minors

- Energy
- Management of technology and entrepreneurship
- Computational science and engineering
- Materials science and engineering
- Biomedical technologies
- Spatial technologies
- Engineering for Sustainability

Any other EPFL Minor is accepted
Registration deadline

- End of the first semester
- Better at the beginning of the semester

Procedure

- Select the minor in IS-Academia
- Contact the Minor advisor
- Fill-in the registration form (copy to SGM)
- Register for courses in IS-Academia
- Withdrawal from a Minor: contact SGM to convert part of the Minor’s ECTS to electives
Specialization is elective

- Domain consolidation
- 30 ECTS with variable fundamental base courses
- EPFL rule under modification: minor vs specialization!!!

30 credits fundamental base courses:

- A Mécanique des fluides: 17
- B Automatique et systèmes: 9
- C Conception et Production: 17
- D Sciences thermiques: 15
- E Mécanique des solides et des structures: 8
- F Biomécanique: 8
Semester projects in Mechanical Engineering

- Projects I: mandatory (10 ECTS)
- Project II: elective (10 ECTS)

Registration procedure

- Find a project (Lab websites, contact an SGM teacher)
- Register for the project in IS-Academia and print the registration form
- Get the form signed by the SGM teacher in charge of the project
- Submit the signed form to SGM
The SHS program is over two semesters (Fall-Spring)

**SHS (social and Human sciences)**


REGISTER NOW!
D. Specific information

Industrial internship

When?
- Before the Master Project (PDM)
- With the Master Project (PDMe)

Duration
- ≥8 weeks, ≤6 months
- 25 weeks if combined with the Master Project

Full presentation will take place in Oktober, 12:00 – 13:00

Hind Klinke
D. Information spécifique

Industriel internship

- **Master cycle**: 60 credits
- **Minor/spec**: 30 credits
- **Internship**: 8 weeks
- **Internship**: 6 months
- **PDM in academia**: 17 to 25 weeks, 30 credits
- **Master project in Industry**: 25 weeks, 30 credits
2 alternatives

- At EPFL under the (co)supervision of an SGM teacher
- Outside EPFL (University or company, combined or not with the internship) under the (co)supervision of an SGM teacher

Duration

- at EPFL: 17 weeks
- outside EPFL: 25 weeks
You need to pass each exam

The 44 ECTS in Mechanical Engineering can only come from the list in the Excel sheet

You need 30 ECTS for a specialization

If you do a Minor you are not allowed to take any additional ECTS outside Mechanical Engineering

Begin your SHS this Fall

To begin you Master Project you must have passed at least 82 ECTS

Dedicated presentation with Q&A: Monday 26 September
E. Professors and laboratories

**ECPS**
Emergent Complexity in Physical Systems

**LFMI**
Laboratory of Fluid Mechanics and Instabilities

**UNFOLD**
Unsteady Flow Diagnostics Laboratory

**SCI-STI-MF**
MF group Cavitation

**IPESE**
Industrial process and Energy Systems Engineering

**LRESE**
Laboratory of Renewable Energy Science and Engineering

**SCI-STI-JVH**
JVH Group: Solid Oxide Fuel Cells

**LNET**
Laboratory of Nanoscience for Energy Technologies
E. Professors and laboratories

LAMMM
Laboratory for Multiscale Mechanics Modeling

FLEXLAB
Flexible Structures Laboratory

EMSI
Engineering Mechanics of Soft Interfaces

NEMS
Advanced Nano-electromechanical Systems Laboratory

MICROBS
MicroBioRobotic Systems Laboratory

LBO
Laboratory of Biomechanical Orthopedics
### E. Professors and laboratories

<table>
<thead>
<tr>
<th>LA3</th>
<th>SCI-STI-GFT</th>
<th>SCI-STI-AK</th>
<th>SYCAMORE</th>
<th>LIS</th>
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<tbody>
<tr>
<td>Automatic Control Laboratory 3</td>
<td>GFT-Group Control (microgrids, systems)</td>
<td>AK-Group Data-driven modelling and control</td>
<td>Systems Control And Multiagent Optimization Research</td>
<td>Laboratory of intelligent systems</td>
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<tr>
<th>LAMD</th>
<th>RRL</th>
<th>CREATE-LAB</th>
<th>INSTANT-LAB</th>
<th>LMTS</th>
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</thead>
<tbody>
<tr>
<td>Laboratory for Applied Mechanical Design</td>
<td>Reconfigurable Robotics Lab</td>
<td>Computational robot design and fabrication Lab</td>
<td>Micromechanical and Horological Design Laboratory</td>
<td>Soft Transducers Lab</td>
</tr>
</tbody>
</table>
Thanks for your attention

Questions?
EPFL Library

At the Rolex Learning Center
Open 7/7 – 7am to midnight
Services at the desk
8am to 8pm – Monday to Friday

Many training sessions
to acquire new skills
Citation, plagiarism, information retrieval, bibliographies, etc.

Hundreds of millions of documents available on site and online
Register online
go.epfl.ch/siwsscovery-network

Study spaces
Quiet and silent areas, Meeting rooms, equipments, etc.

EPFL Library
go.epfl.ch/library