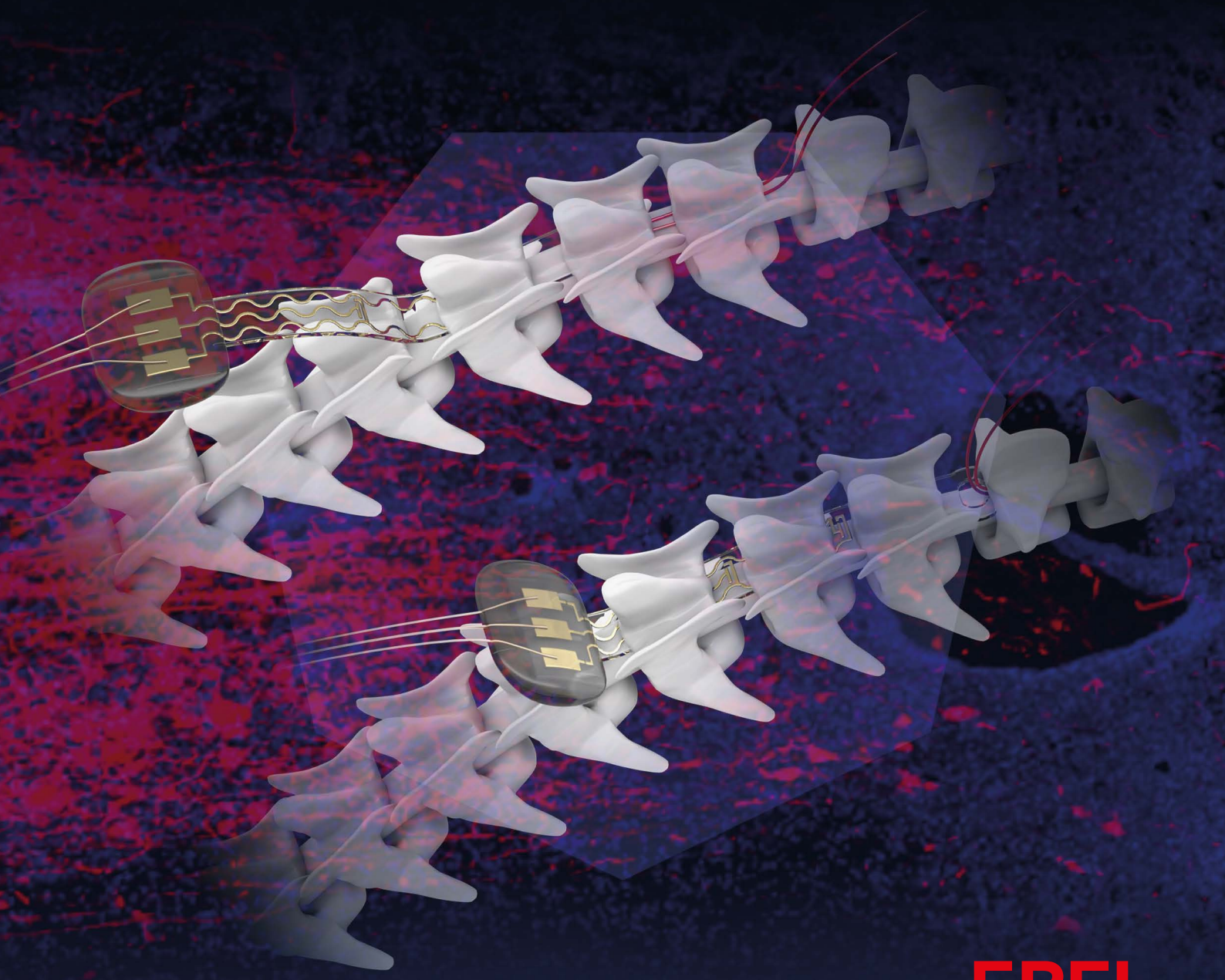
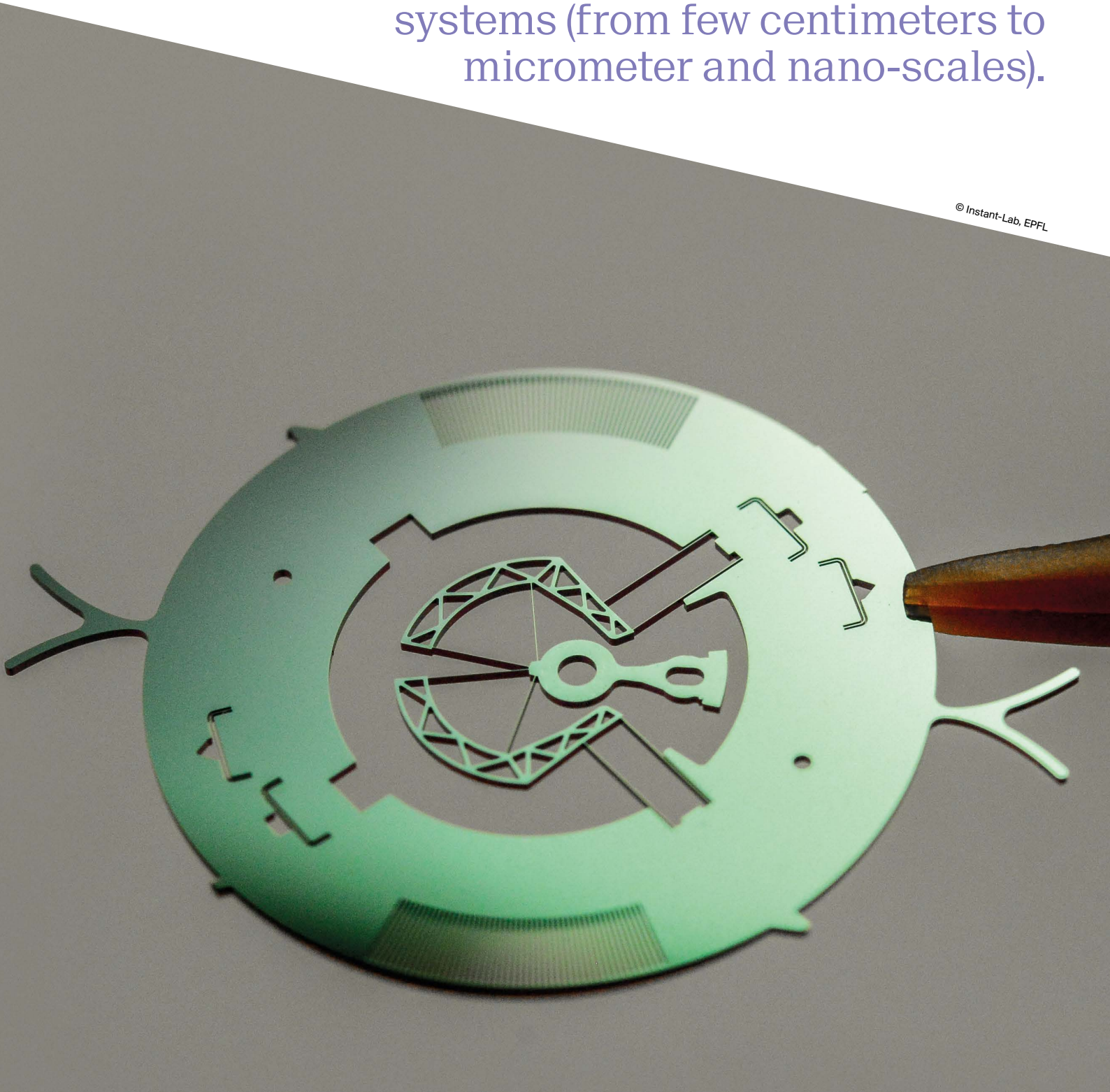
MICROENGINEERING

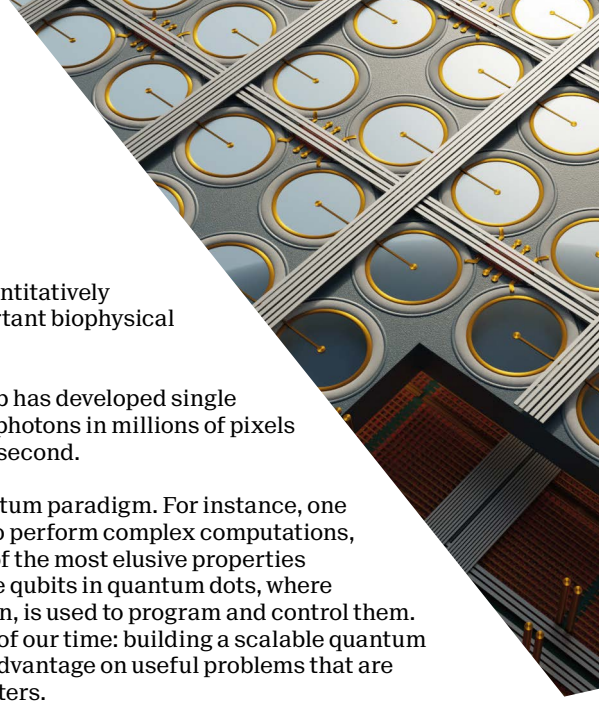
MASTER



EPFL

This program focuses on building complex systems with a strong multidisciplinary approach by integrating sensors, actuators, electronics, innovative materials and smart computational elements. In addition to their classes in micro-nano systems, optics, photonics and advanced manufacturing, students learn by designing, prototyping and validating complete miniaturized systems (from few centimeters to micrometer and nano-scales).





Quantum technology: from sensing to computing

Prof. Edoardo Charbon

The capability of detecting single photons has many advantages; as it enables to quantitatively sense light and this is useful when bursts of light and therefore can determine important biophysical properties of the material the target is made of.

In order to do so efficiently and very quickly, the AQUA lab has developed single photon avalanche diodes (SPADs) capable of detecting photons in millions of pixels simultaneously, hundreds of thousands of times in a second.

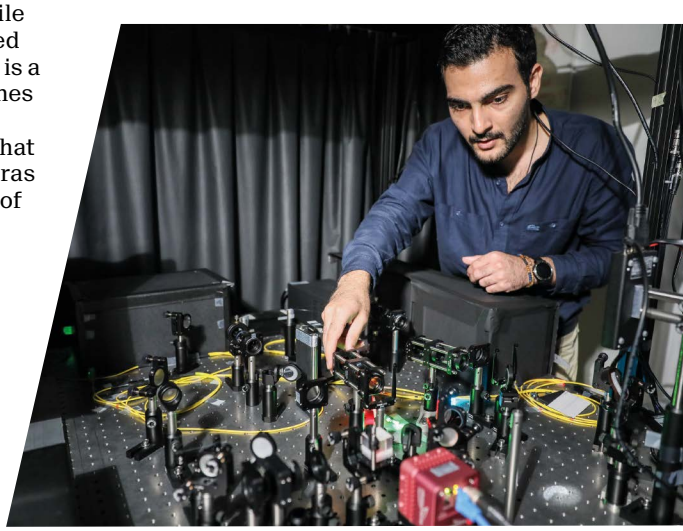
But sensing is only one aspect involving the quantum paradigm. For instance, one can also use photons as quantum bits (qubits) to perform complex computations, using superposition and entanglement, two of the most elusive properties of quantum mechanics. One can also house qubits in quantum dots, where electronics cooled to a few degrees Kelvin, is used to program and control them. This is one of the most exciting quests of our time: building a scalable quantum computer to demonstrate quantum advantage on useful problems that are intractable on today's supercomputers.

Laetitia Imstepf: "This master's degree allowed me to acquire experience in an academic and professional way. Moreover, its multidisciplinary nature gave me the opportunity to deepen my theoretical and practical knowledge in different scientific fields such as electronics, biology or mechanics."

Optics and artificial intelligence

Prof. Christophe Moser and Prof. Demetri Psaltis

Light can also be used as a mean for computing. For example, fast, and power efficient deep neural networks can be realized by leveraging the complex transformation that light undergoes while propagating in optical fibers – the same type used for digital communication. The optical computer is a complex system that combines the many disciplines taught in the Microengineering Master's program such as digital programming, control electronics that synchronize the light beams with high-speed cameras as well as light modulators and requires knowledge of non-linear optical phenomena.



The technique that was developed is known under the nickname SOLO and it has shown remarkable accuracy while carrying out the computation for several different tasks, such as detecting COVID infections in lungs X-rays. The optical computer has done this at a fraction of the energy consumption compared to electronic, digital implementations.

Jonathan Wei : "What I liked most about this master's degree is that it gives you a lot of freedom to choose the courses you are interested in. The range of available classes is very wide too, allowing you to pick very different subjects related to microengineering."

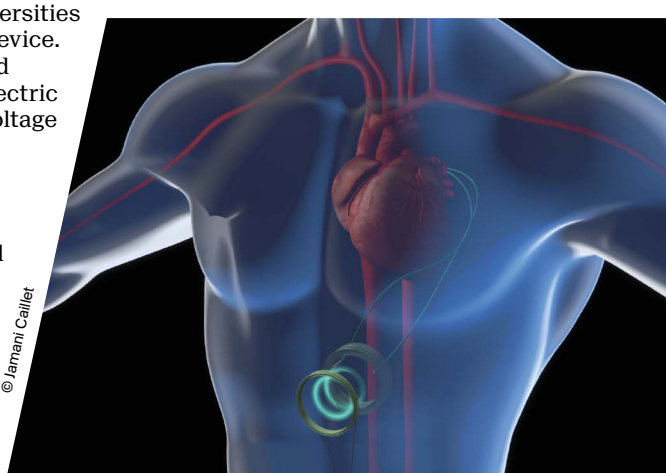
Creating artificial muscles

Prof. Yves Perriard

EPFL Center for Artificial Muscles (CAM) is becoming a leading reference for the development and clinical transfer of a brand-new technological approaches to artificial muscles in the human body.

One of their main project developed in collaboration with the Universities of Bern and Zurich focuses on an augmented aorta as a cardiac assist device. To achieve this ambitious goal of an artificial heart, the CAM team developed various Microengineering technologies for high-power actuation (tubular dielectric elastomers), biocompatible materials, wireless energy transfer and step-up voltage modules as well as smart automated test-benches simulating the blood-flow.

Other projects developed in this Center include - an artificial sphincter to help patients suffering either from urinary incontinence or from an underactive bladder, and a flat, activated membrane to restore chewing function and facial expressions.



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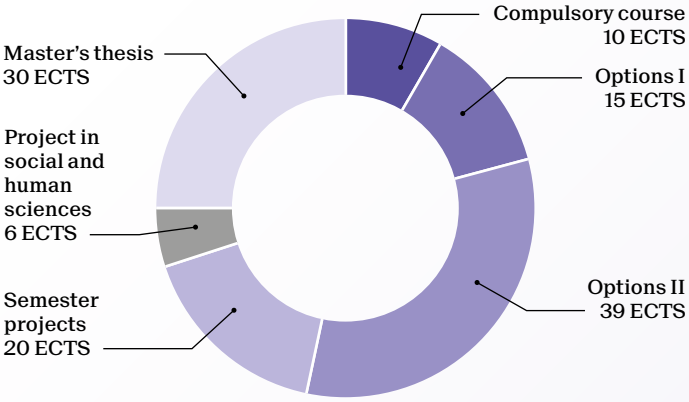
Master of Science in

MICROENGINEERING

2-year program - 120 ECTS



Industrial internship

The program includes a compulsory 8-week internship which can be extended to 6 months and/or combined with the Master's thesis.

Students may choose a 30 ECTS minor within the optional courses. Recommended minors with this program:

- Biomedical technologies
- Computational science and engineering
- Data and Internet of things
- Energy
- Engineering for sustainability
- Management, technology and entrepreneurship
- Neuro-X
- Photonics
- Physics of living systems
- Quantum science and engineering
- Space technologies

Admission criteria

EPFL Bachelor's degree in Microengineering.

A Bachelor's degree in Computer Science, Electrical Engineering, Mechanical Engineering, or any related field with an interdisciplinary background and an excellent academic record may also be accepted. However, candidates must master at least two of the three following fields: computer science, electronics, and mechanical engineering. Additional credits to fill any gaps may be required.

Career prospects

The EPFL MSc in Microengineering opens a broad range of career opportunities in research departments and manufacturing units over the entire industry spectrum, from start-ups to multinational groups. Microengineers are highly sought after in high-tech sectors, where their solid and broad profile empowers them to lead research and development, as well as to oversee production in industries ranging from aerospace and medtech to the watch industry.

School of Engineering
go.epfl.ch/master-microengineering
contact: smt@epfl.ch

	Credits
Compulsory course	**10**
Products design and systems engineering	10
Options I	**15**
Advanced MEMS and microsystems	3
Applied and industrial robotics	2
Applied machine learning	4
Apprentissage et intelligence artificielle	4
Imaging optics	3
Introduction to additive manufacturing	3
Laser fundamentals and applications for engineers	3
Low-power radio design for IoT	3
Manufacturing systems and supply chain dynamics	3
Materials and technology of microfabrication	3
Materials processing with intelligent systems	3
Metrology	3
Nanotechnology	3
Optical detectors	3
Scaling laws and simulations in micro- and nanosystems	4
Selected topics in advanced optics	3
Smart sensors for IoT	3
Options II	**39**
Advanced additive manufacturing technologies	3
Advanced analog integrated circuit design	2
Advanced control systems	3
Advanced machine learning	4
Advanced satellite positioning	4
Aerial robotics	4
Analyse de produits et systèmes	2
Applied biomedical signal processing	4
Audio	3
Basics of mobile robotics	4
Bioimage informatics	4
Biomedical optics	3
Biomicroscopy I, II	7
Bio-nanochip design	3
Commande embarquée de moteurs	3
Commande non linéaire	3
Computational motor control	4
Continuous improvement of manufacturing systems	5
Deep learning for optical imaging	3
Distributed intelligent systems	5
Embedded systems	4
Evolutionary robotics	3
Fundamentals and processes for photovoltaic devices	3
Fundamentals of analog and mixed signal VLSI design	4
Fundamentals of biophotonics	3
Fundamentals of biosensors and electronic biochips	3
Haptic human robot interfaces	3
IC design I	3
Image processing I, II	6
Industrial automation	3
La science quantique : une vision singulière	3
Lab on app development for tablets and smartphones	4
Large-area electronics: devices and materials	3
Laser microprocessing	2
Lasers: theory and modern applications	4
Legged robots	4
Machine learning programming	2
Management de projet et analyse du risque	4
MEMS practicals I, II	4
Metrology practicals	2
Micro- and nanomechanical devices	4
Model predictive control	4
Nanobiotechnology and biophysics	3
Nanophotonics	3
Neural interfaces	6
Neural signal and signal processing	6
Nonlinear optics	3
Optical design with ZEMAX OpticStudio	3
Optics laboratories I, II	6
Organic and printed electronics	2
Photonic systems and technology	4
Physics of photonic semiconductor devices	4
Quantum and nanocomputing	6
Radio frequency circuits design techniques	4
Sensors in medical instrumentation	3
Space mission design and operations	2
System identification	3
Systems engineering	3
Techniques d'assemblage	3
Transducers for classical and quantum applications	4
Translational neuroengineering	6