EPFL

mt

microtechnique
microengineering
section

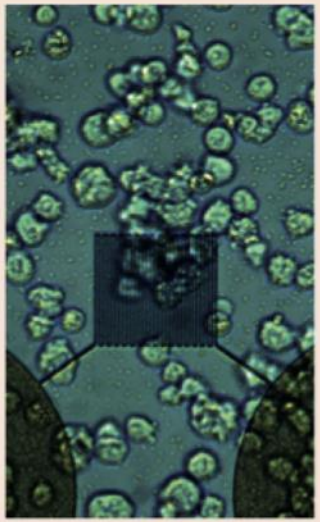
Mineur en Technologies Biomédicales

Faculté des Sciences
et Techniques
de l'Ingénieur (STI)

EPFL mt microtechnique microengineering section

SCHOOL OF ENGINEERING

MINOR IN BIOMEDICAL TECHNOLOGY



The Minor in Biomedical Engineering complements the engineering programmes offered at EPFL, providing additional skills in the field of biomedical sciences and technologies.

The programme includes courses giving a general basis in biomedical sciences as well as a broad choice of engineering-related courses with special emphasis on applications in biomedical engineering.

Students have the opportunity to carry out a research project (semester project, 8 ECTS) in one of the laboratories participating in the programme.

This Minor can be taken in addition to one of the following programmes:

- **Mechanical Engineering**
- **Microengineering**
- **Materials Science and Engineering**
- **Electrical and Electronics Engineering**
- **Chemistry and Chemical Engineering**
- **Physics**
- **Life Sciences**
- **Civil Engineering**

The 30 ECTS credits of the minor are added to the 90 ECTS of the Master (including the 30 ECTS of the Master's thesis) and duly mentioned in the Diploma Supplement.

Switzerland Medtech environment

Top 10 Swiss medtech employers ranked by number of employees (data 2021)

No.	Company	Core activities in Switzerland	Headquarters	Number of employees in Switzerland
1	Jabil	Orthopaedics	USA	2,865
2	Roche Diagnostics	In vitro diagnostics	CH	2,800
3	J&J Medical	Orthopaedics, traumatology, wound treatment	USA	1,600
4	Hamilton[1]	Ventilators, in vitro diagnostics, laboratory automation	CH	1,540
5	Straumann	Dentistry	CH	1,460
6	Sonova[2]	Hearing aid technology	CH	1,445
7	Ypsomed[2]	Injection systems (drug delivery) and diabetes management	CH	1,356
8	Biotronik	Cardiology	GER	1,350
9	Zimmer Biomet	Orthopaedics, traumatology	USA	1,100
10	B. Braun	Wound treatment, hospital equipment and disposables	GER	1,100

+ thousands of SME and start-up

https://www.startup.ch/medtech-startups
https://www.swissbiotech.org/category/services-medical-devices-technologies/
https://www.swiss-medtech.ch

Orthopaedics and traumatology

Dentistry

Ophthalmology

Surgical instruments and technology

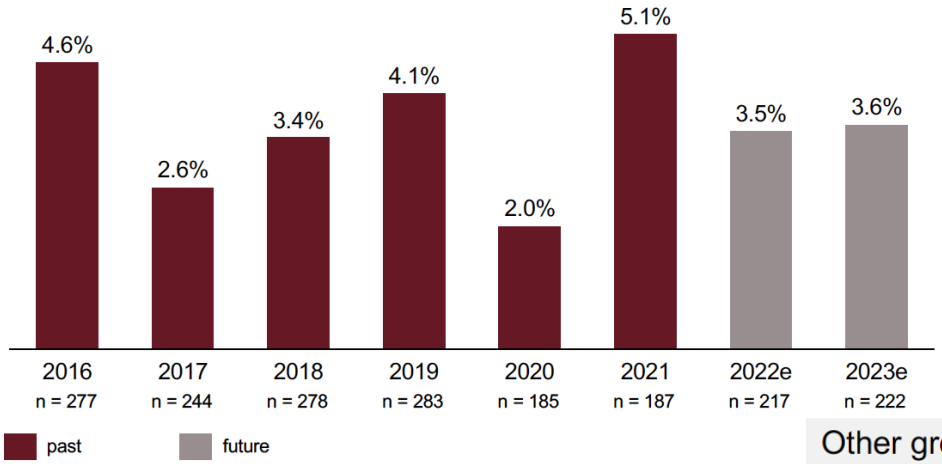
General disposables

In vitro diagnostics and laboratory supplies

Rehabilitation, prosthetics, orthotics and everyday aids

Drug delivery systems and diabetes management

Employment trends in Medtech



4’500 news jobs beween 2020 and 2022

Source: SMTI 2022

Other growth rates for comparison:

- Total number of jobs in Switzerland: +1.4% (2021)
- Number of jobs in the Swiss pharmaceutical industry: +2.2% (2021)

Top trends in medical technologies

Product innovation

1	**Smart devices**	Smart design and engineering, wearables, hearables, implantables, etc.
2	**Materials innovation**	Improved properties: durability, biocompatibility, surfaces, malleability, etc.
3	**Substitution technology**	New sensors for continuous non-invasive and invasive measurement of body data, etc.
4	**Data acquisition**	Internet of things, sensorisation, integration with evaluation software, etc.
5	**Individualisation**	Individualised prostheses and implants, electronic tablets, etc.

Diagnostics

1	**Service automation**	Remote monitoring, automatic ordering of replacement parts, etc.
2	**Patient data processing**	Big data analysis and processing, cyber security, artificial intelligence (AI), pattern recognition in unstructured data. etc.
3	**Personalised medicine**	Precision medicine adapted to genome, patient-specific implants, etc.
4	**Augmented reality / virtual reality**	Viewing internal body structures, visualisation of complex data, simulation of interventions, surgery planning incl. risk management, etc.
5	**Human-machine interfaces**	Intuitive handling, speech recognition, brain-computer interfaces, etc.

Therapy/Treatment

1	**Automation and robotisation**	Robots to support surgical, hospital, and nursing staff, etc.
2	**Decision-making autonomy of physicians**	Automation of interpretation and decision-making based on diagnostic values, etc.

Health care

1	**Patient behaviour: prevention vs treatment**	Integration of preventive health care into everyday life, etc.
2	**Patient's need for information**	Need for information on diseases, healthy living, all forms of treatment and sources, etc.
3	**Telemedicine**	Overcoming spatial or temporal distance for diagnostics and therapy, etc.
4	**Branding**	Brand awareness, etc.

Adapted offer and requisites

The program includes **courses** (22 ECTS minimum, all optional) of basis in biomedical sciences as well as a broad choice of engineering-related courses with emphasis on applications in biomedical engineering.

A **semester project** (8 ECTS, mandatory) related to biomedical technology in included in the Minor.

For non-SV students (STI, SB…)

A core group of courses of biomedical basis is strongly recommended:

PHYS-301	Biophysics : physics of the cell
BIO-105	Cellular biology and biochemistry for engineers
BIO-377	Physiologie par systèmes
MICRO-568	Seminar in physiology and instrumentation

This Minor allows to aquire various fundamentals in many areas of biological and medical sciences

For SV students

SV students will have the opportunity to deepen their engineering knowledge in their domain of interest leveraging the offered courses in the Minor curriculum and possibly select other courses from other engineering programs (up to 10 ECTS, upon agreement of the Minor coordinator

Courseplan

CODE	MATIERES
Groupe "Mineur"	
Projet obligatoire du mineur en Technologies biomédicales	
MICRO-563	Project in biomedical technologies
Bases biomédicales 1)	
PHYS-301	Biophysics : physics of the cell
BIO-105	Cellular biology and biochemistry for engineers
BIO-377	Physiologie par systèmes
MICRO-568	Seminar in physiology and instrumentation
Autres cours	
PHYS-XXX	MRI Practicals on CIBM preclinical imaging systems
NX-XXX	Regulatory, quality and Clinical affairs
EE-518	Analog circuits for biochip
EE-512	Applied biomedical signal processing
EE-519	Bioelectronics and biomedical microelectronics
BIO-410	Bioimage informatics
BIOENG-421	Basics in bioinstrumentation
NX-465	Computational neurosciences: neuronal dynamics
ME-481	Biomechanics of the cardiovascular system
ME-482	Biomechanics of the musculoskeletal system
BIOENG-445	Biomedical optics
MICRO-561	Biomicroscopy I
MICRO-562	Biomicroscopy II
EE-517	Bio-nano-chip design
PHYS-302	Biophysics : physics of biological systems
PHYS-438	Fundamentals of biomedical imaging
BIO-443	Fundamentals of biophotonics
EE-515	Fundamentals of biosensors and electronic biochips
MICRO-321(a)	Ingénierie optique (pour MT)
MICRO-390	Light, liquids and interfaces
ME-480	Mechanobiology: how mechanics regulate life
MICRO-331	Microfabrication technologies
CH-413	Nanobiotechnology
NX-422	Neural interfaces
NX-421	Neural signals and signal processing
BIO-482	Neuroscience: cellular and circuit mechanisms
BIO-491	New tools & research strategies in personalized health
ME-484	Numerical methods in biomechanics
EE-511	Sensors in medical instrumentation
NX-423	Translational neuroengineering

Science & technology domains related to Medtech

- Proteomics
- Genetics and sequencing
- In vitro models
- In vitro diagnostics
- Neuroengineering
- Sensors and instrumentations
- Reabilitation and prosthetics
- Imaging and Biomedicla signals treatment
- Digital diagnostics, data interpretation tools
- Biomaterial, Tissue engineering
- Biomechanics
- Surgical instruments and robotics
- Microsystems for sample processing and analysis (Biomems, lab-on-a-chip)
- …