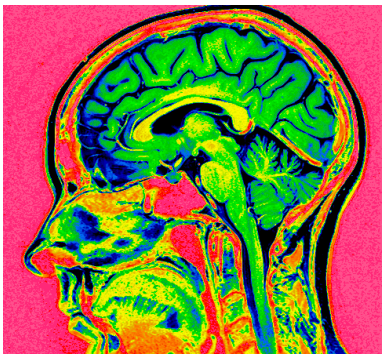
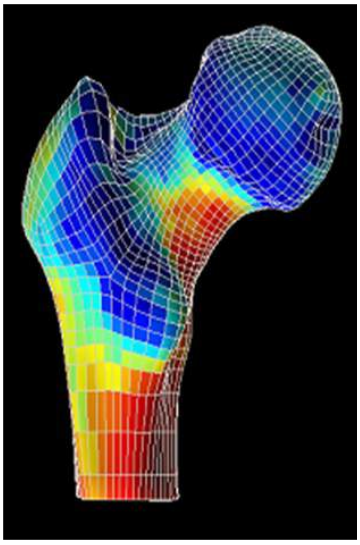
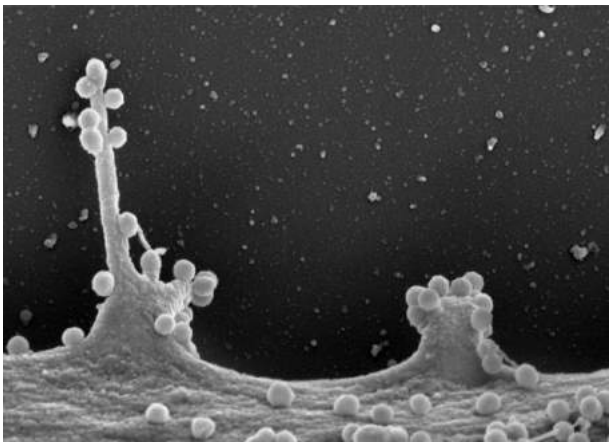
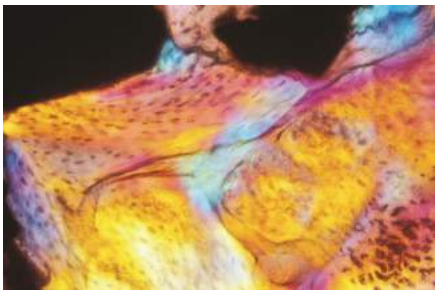
BioMedical Engineering

Master's Degree Program









UNIVERSITÉ PARIS DESCARTES
SCIENCES FONDAMENTALES ET BIOMÉDICALES

USPC Université Sorbonne Paris Cité

bme Paris BioMedical Engineering MASTER PROGRAM

ParisTech INSTITUT DES SCIENCES ET TECHNOLOGIES PARIS INSTITUTE OF TECHNOLOGY

BioMedical Engineering
Master's Degree Program

Chair persons

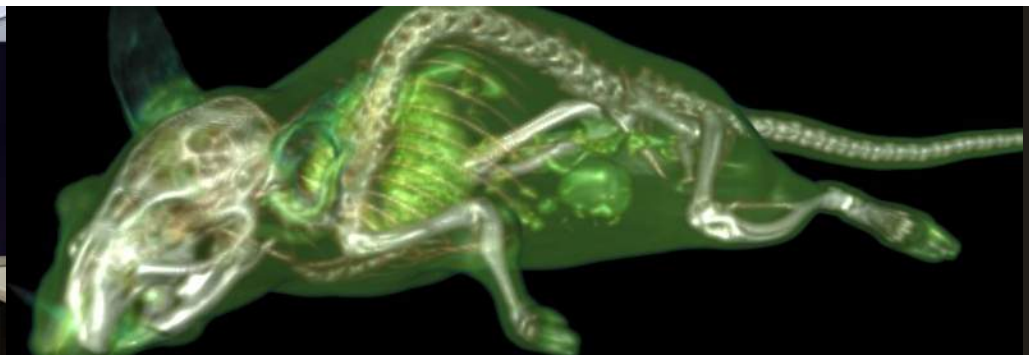
Pr. Sébastien LAPORTE, PhD
Arts & Métiers

Pr. Robert Barouki, MD, PhD
Université Paris Descartes

The BME-Paris Master's Degree Program offers two years of academic and professional training in bioengineering, a burgeoning field at the crossroads of the biomedical and engineering sciences. This program results from a partnership established between Paris-Descartes University and the Paris Institute of Technology (ParisTech).

Firmly based on an interdisciplinary approach, the BME-Paris Master's relies on international collaboration and features strong student initiative. These principles are strengthened by the complementary competencies of the program's two outstanding academic partners: Paris-Descartes in the biomedical and health sciences and ParisTech in the engineering sciences.

This jointly sponsored program offers a high-quality curriculum to students arriving from a broad range of academic backgrounds: biology and biochemistry, medicine, chemistry, physics, engineering, mathematics and computer science, etc… The aim of the BME Paris Master's is to provide students with the tools and capacities that will enable them to function in a broad range of biomedical engineering applications that today rank among the most scientifically innovative and rapidly developing areas of academic research, industrial R&D, and the clinical environment.



Assets available

- High-profile teaching staff: research specialists of international stature
- Interdisciplinary research projects and seminars
- Unique student environment at Paris-Descartes and ParisTech
- Individual, tailor-made support for students

Skills taught

- Use of interdisciplinary approaches in developing innovative research projects in bioengineering fields
- Planning and conducting scientific / technological projects; analysis, diagnosis, modeling, experimental protocols, result interpretation
- Oral and written scientific communications for international conferences and peer-reviewed journals
- Adapting to professional environments; teamwork, adjusting to new or different contexts and corporate cultures
- Scientific and medical ethics

Professionnal opportunities

The BME-Paris Master's program provides high-quality graduate education in scientific research, including lecture courses, seminars, and laboratory training by internationally recognized scientists. The program prepares students for positions in academia (teaching and research), industry (R&D), and the clinical environment (healthcare).

Other opportunities are available through the close partnership that exists between Paris-Descartes and ParisTech. At the end of the first year, BME students may apply to continue for a second year at other ParisTech schools. At the end of the second year, students from a nonmedical background may apply for entry into the third year of medical studies at Paris-Descartes.

Admission

Applications for admission to the BME-Master's Degree program are reviewed by an admission committee consisting of members of the program's international teaching staff. The application form may be downloaded from the following web site: http://www.bme-paris.com.

Entrance requirements

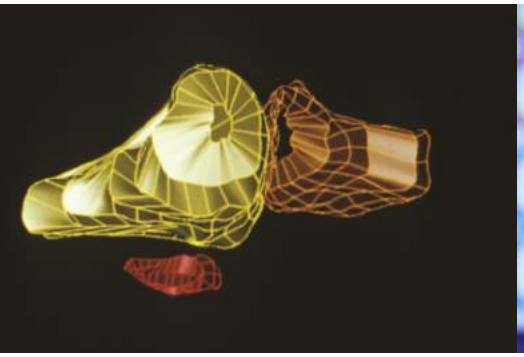
This BME-Paris Master program is open to highly motivated students of all nationalities, with a scientific, biomedical sciences or engineering curriculum. Admission can be considered at either M1 or M2 level (see details on www.bme-paris.com).

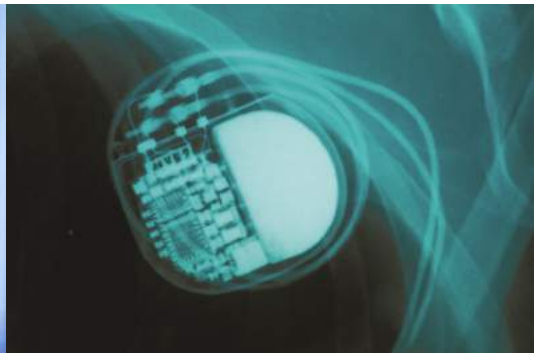
Language requirements

All courses and examinations are in English. Applicants must read, speak, and write English fluently.

Location

All teaching sites are located in the heart of Paris.

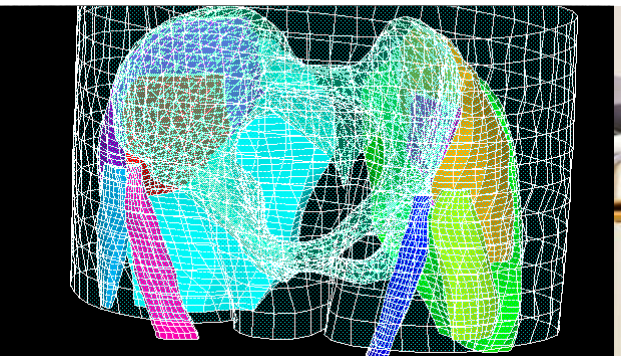




MASTER 1 (semesters 1 & 2)

MASTER 2 (semesters 3 & 4)

- **Bioimaging (BIM)** *(pp 6 to 9)*
  - *Imaging from Molecule to Human (IMH)*
  - *Imaging Modalities & Processing (IMP)*
- **Bioengineering and Innovation in Neurosciences (BIN)** *(pp 10 & 11)*
- **BioMaterials (BioMAT)** *(pp 12 & 13)*
- **Biomechanics (BioMECH)** *(pp 14 & 15)*
  - *Impact & Injury Mechanisms (I2M)*
  - *MusculoSkeletic System(MS2)*
  - *Clinical BioMechanics (CBM)*
- **Molecular & Cellular Biotherapies (MCB)** *(pp 16 & 17)*



Master 1st year

Chair persons

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Université Paris Descartes

M. Pietri, PhD
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The first year of the BME-Paris Master's (M1) is intended to strengthen and broaden students' capacities in specific engineering and biomedical subjects.

Considering the wide variety of academic origins and backgrounds of the students, five 6-credit (ECTS) courses (UE) chosen from among the eight offered must be taken during the first semester of the M1 year in order to fill-in gaps in individual students' capacities in a wide spectrum of fundamental science subjects. For example, an engineering graduate would be required to take Anatomy & Physiology and a life-science or medical school graduate would have to follow courses in signal-processing and solid or fluid mechanics.

In preparation for their 2nd year of studies (M2), students must select one or several pre-specialization courses (a total of five are proposed) during the second semester.

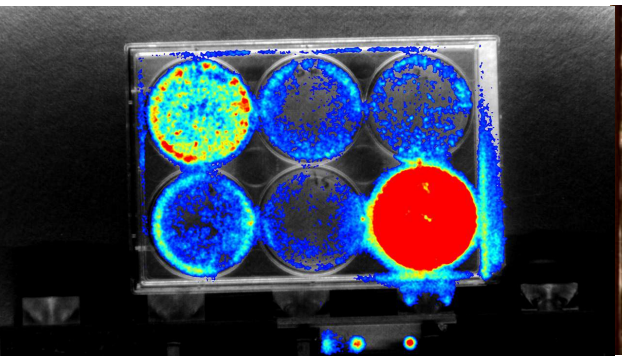
Core courses

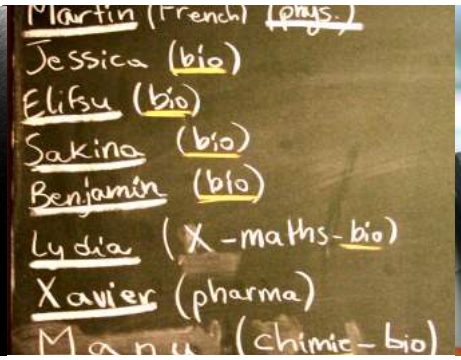
First semester

UE 1.0 - *Seminars, projects, language, culture*
UE 1.1 - *Anatomy & Physiology*
UE 1.2 - *Life chemistry & biocompatibility*
UE 1.3 - *Molecular, cell & tissue biology*
UE 1.4 - *Medicine & science*
UE 1.5 - *Fluid & solid mechanics*
UE 1.6 - *Physics for biomedical imaging*
UE 1.7 - *Computer programming*
UE 1.8 - *Applied mathematics*

Second semester

UE 2.1 - *Scientific communication*
UE 2.2 - *Biomedical modeling*
UE 2.3 - *Pre-specialization : BIM, BIN, BioMAT, BioMECH, MCB*
UE 2.4 - *Lab training, research internship, tutored projects*





BioImaging (BIM)

Chair persons

F. Cloppet, PhD
Université Paris Descartes

Pr. C. Oppenheim, MD, PhD
Université Paris Descartes

E. Angelini, PhD
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Columbia University

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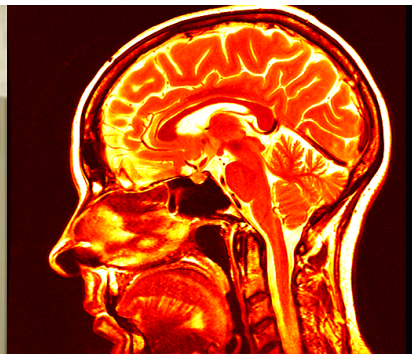
Bioimaging is an exciting and growing field at the interfaces between engineering, mathematics and computer sciences, as well as chemistry, physics, life sciences, and medicine. Bioimaging focuses on the development and usage of imaging modalities to advance diagnosis, understanding, treatment, and prevention of human diseases.

The BIM track offers high-level interdisciplinary education and training supported by the complementary skills of Paris-Descartes and ParisTech. A large network of research laboratories provides students access to industrial and experimental imaging systems that utilize innovative technologies.

The BIM track is accessible to engineering, science and life-science students (medicine, pharmacology, biology, chemistry, biochemistry, physics, mathematics) preparing for career paths in academic research or industrial R&D environments. It relies on close collaborations between Paris-Descartes**, several** ParisTech engineering schools (Telecom, ESPCI, Mines, Chimie, Arts & Métiers, IOGS: Institut d'Optique) **and research institutes including CEA-Neurospin, and Institut Pasteur**. The BIM curriculum offers 15 courses (UE) that cover medical and biological imaging technologies, image processing, contrast agent principles and clinical applications such as functional or molecular imaging.

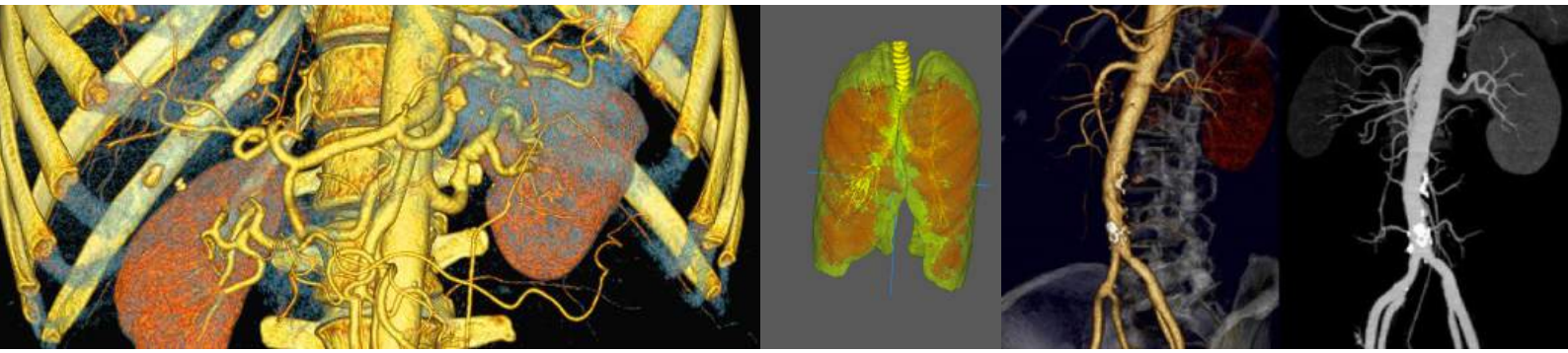




During the M2 year, students select two 6-ECTS courses (UE) from a core syllabus, two 3-ECTS UE to specialize in one of the two subtracks (IMH and IMP), and 9 more ECTS in one of the sub-tracks, or in the common-core, or in another track. Students' elective courses are determined according to their professional objectives and approval by the BIM pedagogical committee.

The bioimaging track places strong emphasis on the basic sciences (mathematics, physics, chemistry) and applied mathematics (image-processing, numerical analysis).

Core courses
Third semester
UE 3.0 – *Seminars & conferences*
UE 3.1 – *Interdisciplinary week*
UE 3.2 – *Optical imaging – level 1*
UE 3.3 – Medical image analysis – *level 1*
UE 3.4 – *Diagnostic imaging*
UE 3.5 – *Chemistry for imaging*
UE 3.6 – *Physics and Technology of medical imaging*
UE 3.7a – *Molecular chemistry for imaging*
UE 3.7b – *Optical Imaging, Level 2 - Advanced Optical Methods for Neurosciences (from Master Erasmus MONABIPHOT)*
UE 3.8a – *Advanced Biology for imaging*
UE 3.9a – *Molecular Imaging*
UE 3.10a – *Functional and Metabolic Imaging*
UE 3.10b – *Medical image Analysis level 2*
UE 3.11b – *Advanced Modeling and Analysis of NeuroImaging Data*
UE 3.12b – *Advanced Modeling and Analysis of Biological Imaging Data*
Fourth semester
UE 4.0 – *Ethics in bioengineering*
UE 4.1 – *Bioengineering Economy and Industry*
UE 4.2 – R*esearch Internship*

A. **Subtrack IMP : Imaging Modalities & Processing**
B. **Subtrack IMH : Imaging from Molecule to Human**



Subtrack « Imaging Modalities & Processing (IMP) »

Contact

Elsa ANGELINI
Telecom ParisTech
Columbia University

Pr. Catherine OPPENHEIM
Université Paris Descartes

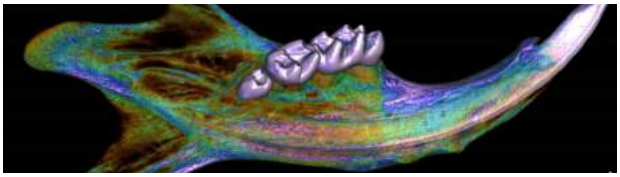
IMP@bme-paris.org

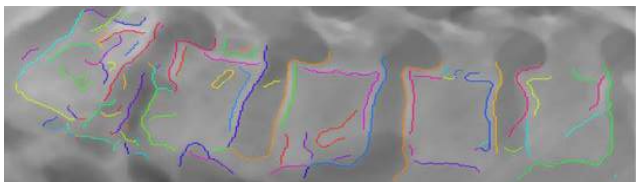
Subtrack courses
UE 3.7b – *Optical Imaging, Level 2 - Advanced Optical Methods for Neurosciences (from Master Erasmus MONABIPHOT)*
UE 3.10b – *Medical image Analysis – level 2*
UE 3.11b – *Advanced Modeling and Analysis of NeuroImaging Data*
UE 3.12b – *Advanced Modeling and Analysis of Biological Imaging Data*

The Imaging Modalities and Processing (IMP) track provides in depth multidisciplinary training to engineers and scientists (mathematics, physics) in medical and biological imaging modalities and image processing.
Emphasis is placed on methods used for image data extraction dedicated to interpretation, diagnosis, therapeutic follow up and modeling. Novel applications are introduced, such as image-guided treatment, elastography or molecular and functional imaging. IMP courses provide students with solid technical training in the physics of medical imaging modalities, technologies involved in acquisition systems, and image processing methods for the extraction of anatomical and biological information.
There is a strong emphasis put on the quantification of image-based information for specific diagnosis (e.g. brain tumors, stroke,…) and image-based modeling of biological and anatomical structures.

Teaching is mainly provided by engineering faculty, researchers, and radiologists who are highly familiar with technical innovations related to computational methods, imaging systems, and innovative therapies. A wide network of research and clinical laboratories at ParisTech and Paris-Descartes provide students an access to industrial and experimental imaging systems. Several courses even provide the opportunity to manipulate such systems.

The training offered in the IMP track will qualify students for employment in the broad sector of biomedical imaging, which includes industrial manufacturers (whole-body scanners and microscopic systems), image-processing software editors, and hospital or R&D departments that use biomedical image processing tools (e.g. pharmaceutical and cosmetic groups). Students can also pursue their studies toward a Ph.D. degree in biomedical engineering, applied mathematics, computer science, physics or medical science.





Engineering students can also apply for integration of the French medical schools at the 2nd or 3rd year level.

Subtrack « Imaging from Molecule to Human (IMH) »

The Imaging from Molecule to Human (IMH) track provides in depth multidisciplinary training to clinicians and material or life-scientists (biophysics, pharmacology, chemistry, biology, medicine), in medical and biological imaging modalities, analysis and use in the clinic. Students are provided with a broad prospective of the domain and the high-level-technical skills needed to work on novel and innovative-imaging- solutions.

Medical students will acquire training in biomedical imaging that will enable them to manipulate a wide variety of screening modalities and to master image processing tools for clinical research.

This track offers a unique combination of courses, involving instructors from various fields, including particle and molecular imaging, biology, medicine, image acquisition systems and physics principles, as well as image processing for computer aided diagnosis. Courses are taught by engineers, researchers, university faculty, and physicians specialized in radiology, from ParisTech and the Universities Paris Descartes and Paris Diderot. This diversity enables students to gain specific training in innovative technologies within the biological and medical imaging domain.

This high-level interdisciplinary education program qualifies students to seek jobs in industry (R&D departments) or to pursue their education towards a Ph.D. degree.

Contact

Florence CLOPPET
Université Paris Descartes

Pr. Catherine OPPENHEIM
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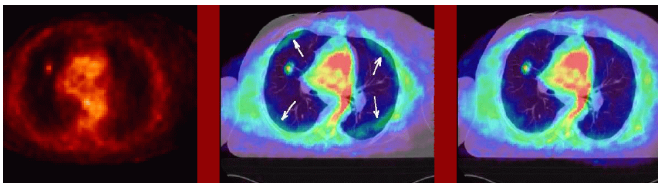
Subtrack courses
UE 3.7a - *Molecular Chemistry for Imaging*
UE 3.8a - *Advanced Biology for Imaging*
UE 3.9a - *Medicine: Molecular Imaging*
UE 3.10a - *Medicine: Functional and Metabolic Imaging*



Bioengineering and Innovation in Neurosciences (BIN)

Chair persons

A. Klarsfeld, PhD
ESPCI ParisTech

P-P. Vidal, MD, PhD
Université Paris Descartes

bein@bme-paris.org

This specialty, hosted by ESPCI ParisTech, Arts & Métiers and Paris Descartes, is designed both for engineering school students and for university students having a robust initial training in basic sciences or medicine. Courses will mesh engineering, mathematics, and computer concepts with molecular, cellular and systems neuroscience.

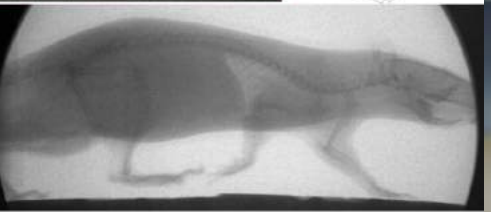
BIN students will contribute to bridge the gap between basic, clinical, and engineering neuroscience. This is a key issue for both industry and medicine in the 21st century, because of:

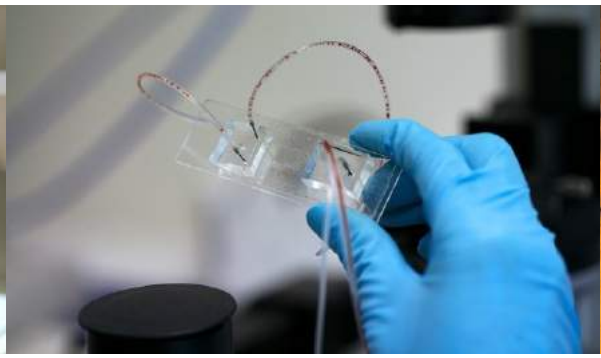
1. the requirement of integrative methods and concepts, from the behavioral to the molecular level, to understand how the central nervous system functions, and can be repaired and enhanced. The neurosciences strongly illustrate the interdisciplinarity that lies at the heart of biomedical engineering, requiring the collaboration of doctors and engineers. This was indeed recognized by the recent launch of major research projects such as the Human Brain Project in the European Union, which aims at linking all levels of study into a comprehensive view of brain function, including behavior.

2. strong demands from a broadening range of industries, way beyond the biomedical ones. There is an increasing need to understand how humans interact with their environments in general and with the new complex working environments of today in particular (human factor). Many industries will thus require engineers with both good engineering skills and basic knowledge of neurophysiology.

3. aging of the world population, which will considerably increase the prevalence of neurodegenerative diseases, and more generally of sensory and motor handicaps. These will require the development of new biomedical devices and molecular tools to better (i) diagnose neurological diseases, (ii) evaluate their progression or treatment, and (iii) remediate disease- or age-associated handicaps.







The BIN specialty has also an **industrial orientation**, by :

1. relying on many lecturers from research and development (R&D) departments of major companies, as well as start-ups. Technical and industrial aspects will be emphasized.

2. offering a practical initiation to innovative entrepreneurship through a Business plan workshop.

3. encouraging students to apply for their 2nd semester internship in an industrial R&D laboratory or a hospital department (Master internships are also offered outside France, providing the candidates find financial support from the host institution and/or grants sponsoring international exchanges).

Employment opportunities cover numerous **professional fields**, such as the **medical device industry** (for medical bioimaging, or advanced sensory and motor remediation), or the **pharmaceutical, cosmetics and chemical industries** (drug design, biosensors), as well as **robotics**, or **the defense, sports, automobile** or **videogame industries**. The BIN specialty can also lead to a PhD thesis in an academic or industrial research laboratory, and subsequently to an academic career in medical or scientific fields.

Courses cover human-machine, brain-machine and brain-computer interfaces, the imaging and manipulation of neuronal and brain activity, predictive chemistry for neuroscience, microfluidics and other innovative miniaturized biotechnologies for the nervous system, statistics, computer modeling of neuronal networks and their applications...

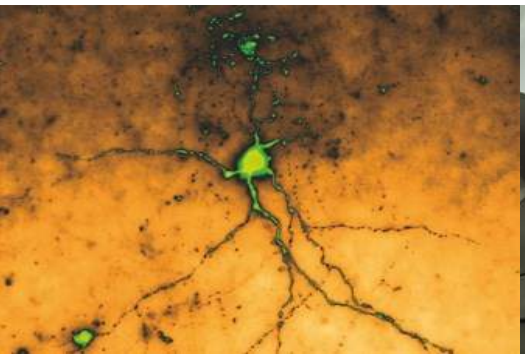
Core courses

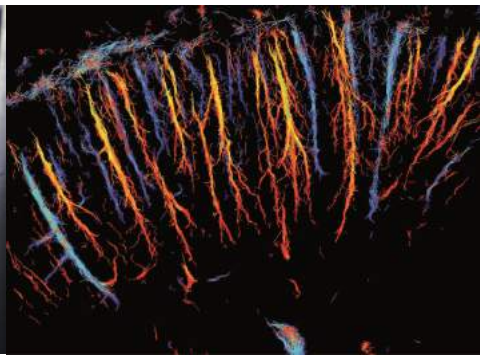
Semester 3 (two subtracks may be offered)

UE 3.0 – *Seminars and conferences (common to all specialties)*
UE 3.1 – *Interdisciplinary week (common to all specialties)*
UE 3.2 – *Tutored project and Methodologies (common to several specialties)*
UE 3.3 – *Refresher courses*
UE 3.4 – *A window into the mind : new technologies to explore and stimulate the brain*
UE 3.5 – *Miniaturisation for neuroscience*
UE 3.6 – *Drug design for neurological diseases*
UE 3.7-8 – *Brain-computer interfaces: from modeling to engineering*
UE 3.9 – *Neuroengineering: sensory supplementation*
UE 3.10 – *Neuroengineering: Motor supplementation and human-machine interface*
UE 3.11 – *Detection of vigilance states and communication with the environment*
UE 3.12 – *Movement analysis and locomotion (common with BM²)*

Semester 4

UE 4.0 – *Ethical aspects of bioengineering (common to all specialties)*
UE 4.1 – *From research to innovation: Business plan workshop*
UE 4.2 – *Research internship (5 months minimum)*





BioMaterials (BioMAT)

Chair persons

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Arts & Métiers

L. Corté, PhD
Mines, ParisTech

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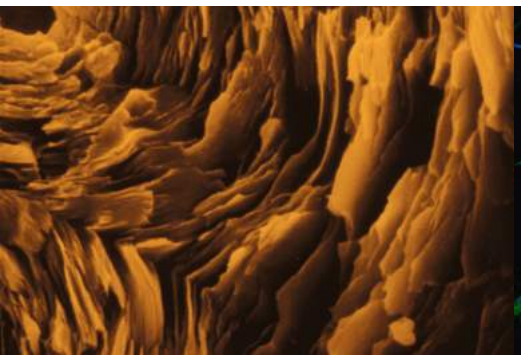
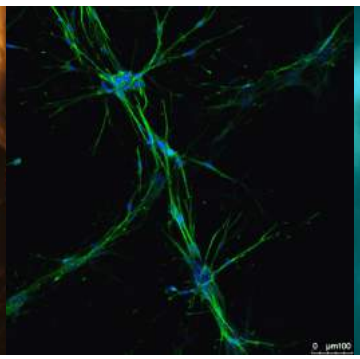
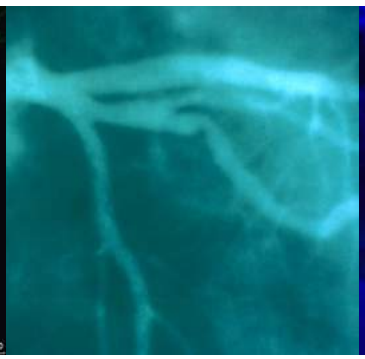
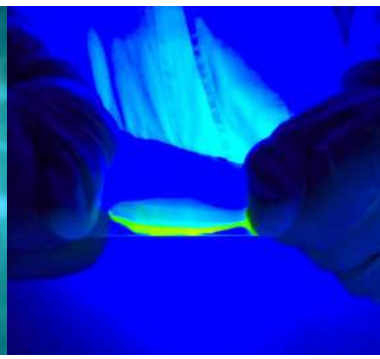
Biomaterials research and development currently not only encompasses, but extends far beyond the field of prosthetics design. Remarkable opportunities for the biomedical field have emerged from the recent progress in the understanding, characterization, and manipulation of biological materials. Design, control, and modelling of biological, bio-sourced, biocompatible, and biomimetic materials are central to numerous biomedical innovations ranging from therapeutic approaches in the field of regenerative medicine to industrial processes.

The BioMAT track provides scientists, engineers, and medical students with the wherewithal to face the numerous challenges of biomaterials R&D; how to apply their skills in order to solve specific biomedical problems, how to carry out innovative and fruitful research with the appropriate methods and ethical considerations, how to collaborate and interact in projects at the interface among materials, biomedical science, and medicine. It is accessible to engineering and life-science students (materials science, physics, chemistry, medicine, pharmacy, dentistry, and biology) preparing for career paths in academic research or industrial R&D environments.

The program provides students in -depth knowledge of the understanding and use of biomaterials, from nanoscale biomolecules, such as proteins, lipids, and synthetic polymers to macroscale prostheses, orthesis, and implants. This education relies on a rich combination of high-level lectures, conferences and exchanges with invited experts and interdisciplinary group projects. From all these experiences, the students will learn how to apply their skills on health-related applications ranging from implant and tissue engineering through the modelling and characterization of biological materials to material design for therapeutics.

Course Selection: Besides the BME conferences and interdisciplinary week, the BioMAT program starts with a set of five core teaching units providing a broad overview of state-of-the-art knowledge of biomaterials science, tissue biology and biomechanics modelling as well as basic concepts in anatomy and research methodology. In-depth focus on biomaterials research is developed in a syllabus of seven teaching units. Each student selects a set of at least four teaching units. A pedagogical commission of lecturers and researchers assists students and helps them to devise a personalized program consistent with their individual backgrounds and professional objectives.

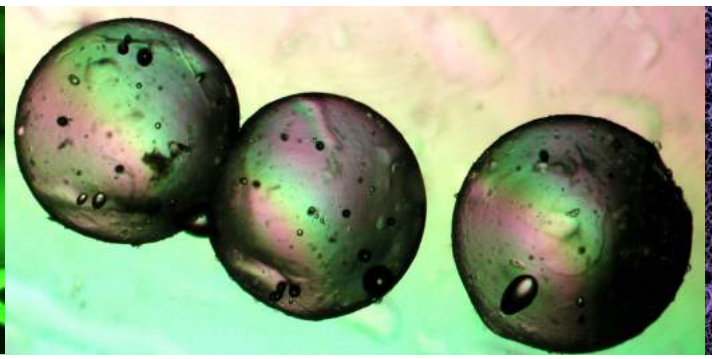
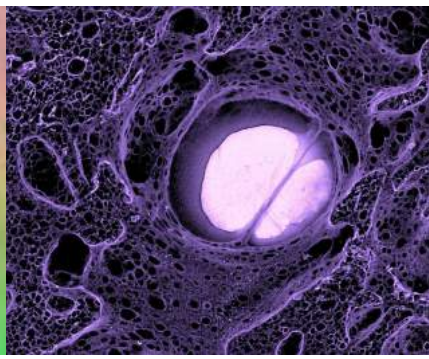
Core courses

Third semester

UE 3.7ab *Mechanical behaviour of biological tissues*
UE 3.7 *General concepts in tissue engineering*
UE 3.8b *Osteoarticular repair*
UE 3.9b *Handling of proteins & biomembranes*
UE 3.10b *Biointerfaces*
UE 3.11b *Cell mechanics, adhesion and motility*
UE 3.12b *Cardiovascular repair*

Fourth semester

UE 4.0 – *Ethical aspects of bioengineering*
UE 4.1 – *Economical & industrial aspects*
UE 4.2 – *Lab training, research internship*

BioMechanics (BioMECH)

Chair persons

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Arts & Métiers

BMBM@bme-paris.org

The BioMechanics track provides fundamental tools and in-depth knowledge on the biomedical applications of mechanics science and related fields.

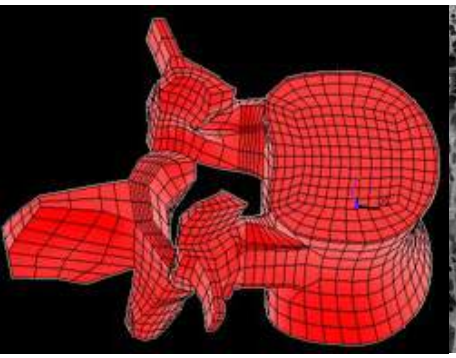
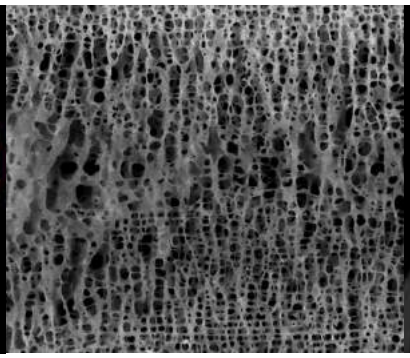
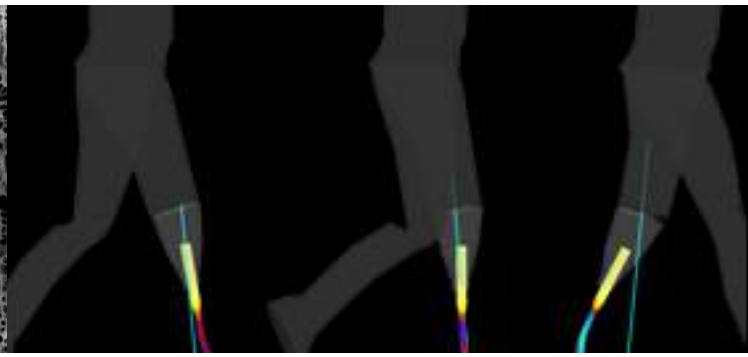
BioMech education and training focus on recent and anticipated developments in biomechanics that hold promise for innovative solutions to major health problems and that respond to industrial challenges.

This program provides scientists, engineers, and medical students with the wherewithal to face the numerous challenges of biomechanics R&D; how to apply their skills in order to solve specific biomedical problems, how to carry out innovative and fruitful research with the appropriate methods and ethical considerations, how to collaborate and interact in projects at the interfaces among mechanics and biomedical science.

The lectures, team projects, case studies, and engineering and medical invited conferences by academic and industrial experts enable students to benefit from a stimulating and multidisciplinary environment.

A set of core teaching units provides a broad overview of basic and state-of-the-art knowledge of biomechanics and its methods. In-depth focus on major biomechanics issues and research is developed in a series of five sub-tracks.

Each student chooses a sub-track and selects a set of at least four teaching units: three specific to the particular sub-track and one from the general master's program. A pedagogical commission of lecturers and researchers assists students and helps them to devise a personalized program consistent with their individual backgrounds and professional objectives.

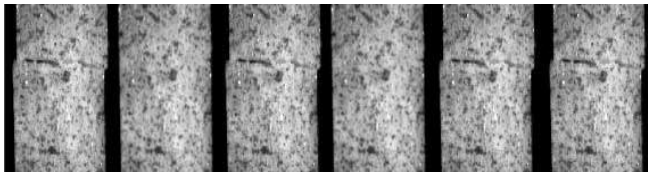
Biomechanical modeling is used in the analysis of musculoskeletal pathologies. The frequency and healthcare impact of these diseases are such that 2000-2010 has been named the "Bones and Joints Decade" by the UN and the WHO. Articular diseases account for half of all chronic pathologies observed after 65 years of age. The prevention of sports traumatisms, as well as sports performance research, require the development of new methods in the effort to understand the behavior of the musculoskeletal system.

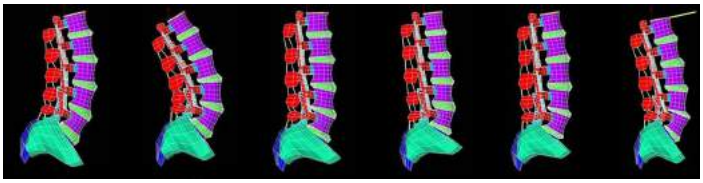
This track will have a particular focus on methods for geometric and mechanical modeling of the musculoskeletal system: finite element approaches, direct and inverse dynamics in relation with gait analysis, modeling of the

Experimental approaches and quantitative functional investigation from medical data are also key issues that will be addressed. Transversal links with the other BME tracks will be encouraged, since musculoskeletal modeling is related to bioimaging, mechanical properties biologic tissues and biomaterials, neuroengineering and biotherapy. In these related fields, light will be brought on specificities when considering the musculoskeletal system.

Example of research projects in this track:

- Experimental and finite element analysis of a disc prosthesis.
- Subject specific modelling of cerebral palsy gait for optimization of therapeutic strategy.
- Finite element modelling for osteoporosis fracture risk prediction.





Core courses

Third semester

UE 3.0 – *Seminars & conferences*
UE 3.1 – *Interdisciplinary week*
UE 3.2 – *Methodology & tutorial project*
UE 3.3 – *Modeling & simulation for biomechanics*
UE 3.4 – *Basics in cell and tissue biology*
UE 3.5 – *Basics in biomaterial science*
UE 3.6 – *Anatomy*
UE 3.7a - *Mechanical behavior of biological tissues*
UE 3.8a - *Accidentology & regulations*
UE 3.9a - *Impact mechanics & high velocities*
UE 3.10a - *Experimental methods for impact biomechanics*
UE 3.11a - *Traumatology, injury mechanisms & therapies*
UE 3.7c – *Mechanical behavior of biological tissues*
UE 3.8c – *Non-linear aspects for the musculoskeletal modeling*
UE 3.9c – *Medical imaging & geometrical modeling*
UE 3.10c – *Muscular system modeling*
UE 3.11c – *Movement analysis & locomotion*

Fourth semester

UE 4.0 – *Ethical aspects of bioengineering*
UE 4.1 – *Economical & industrial aspects*
UE 4.2 – *Lab training, research internship*

Molecular & Cellular Biotherapies (MCB)

Chair persons

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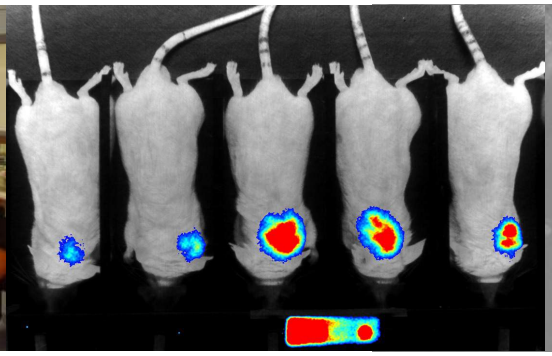
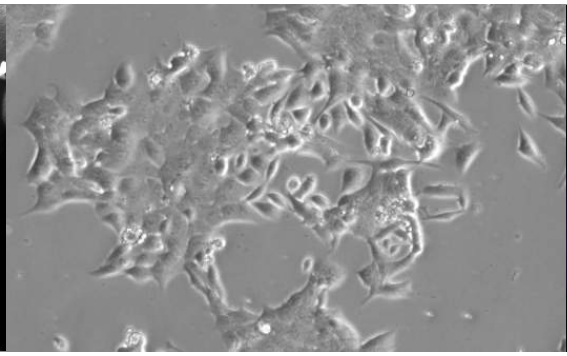
The MCB track is focused on two major categories of biotherapeutics applications: cell and gene therapy, and biopharmaceuticals.

Biotherapies and more specifically Cell and Gene therapies vary from conventional small molecule based therapies in that they relate to the use of a engineered biotherapeutic agent (macromolecule, virus, cell) , often derived from the natural biologic and tailored to the biological need. This translates into a patient-customized treatment, one of the foundation of personalized medicine. The complexity of the manufacturing of biologics makes them difficult to copy and often provides a competitive advantage.

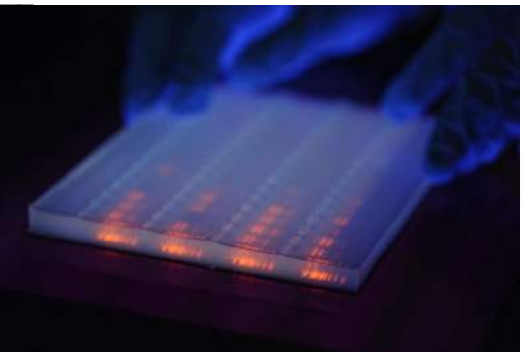
The specific pharmacological and immunological features of biotherapy products, considered to constitute a new generation of drugs, are studied in conjunction with the characteristics of target populations, clinical follow-up, and biological monitoring.

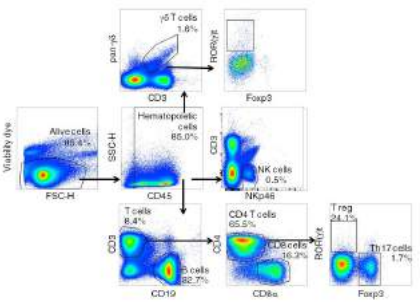




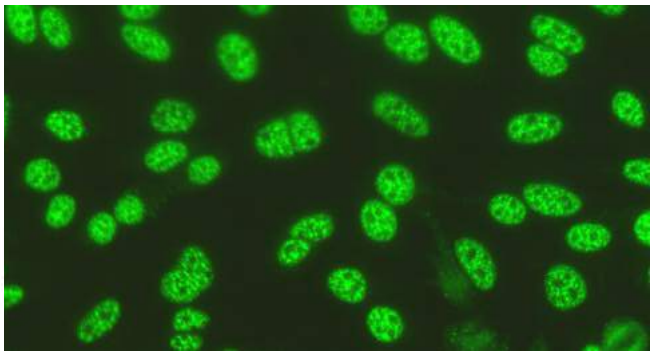
The aim of this track is to train students of advanced scientific level in the field of biotherapy in order to prepare for careers in academia. These students may also find opportunities in industry at the national, European, and international level, particularly in biotechnology and medical research laboratories in teaching hospitals) , as well as in cell and gene therapy firms.

The MCB program is divided into several course units. The first one covers the background and fundamental biological concepts needed to understand the various biotherapeutic approaches.
It also provides an introduction to biological considerations involved in the use of therapeutic tools. The second unit addresses each biological system individually. The remaining two units deal with the study of specific examples, industrial aspects, and regulatory issues involved in the use of various types of biotherapeutic tools, as well as to clinical applications.

Core courses
Third semester
UE 3.0 – *Seminars & conferences*
UE 3.1 – *Interdisciplinary week*
UE 3.2 – *Fundamentals of biotherapy, level 1*
UE 3.3 – *Fundamentals of biotherapy, level 2*
UE 3.4 – *Biological tools for biotherapy*
UE 3.5 – *Cell & tissue biotherapy, level 1*
UE 3.6 – Industrial, biothechnological & pharmaceutical strategies
Fourth semester
UE 4.0 - *Ethical aspects of bioengineering*
UE 4.1 - *Clinical & regulatory aspects*
UE 4.2 - *Cell & tissue biotherapy, level 2*
UE 4.3 - *Lab training, research internship*







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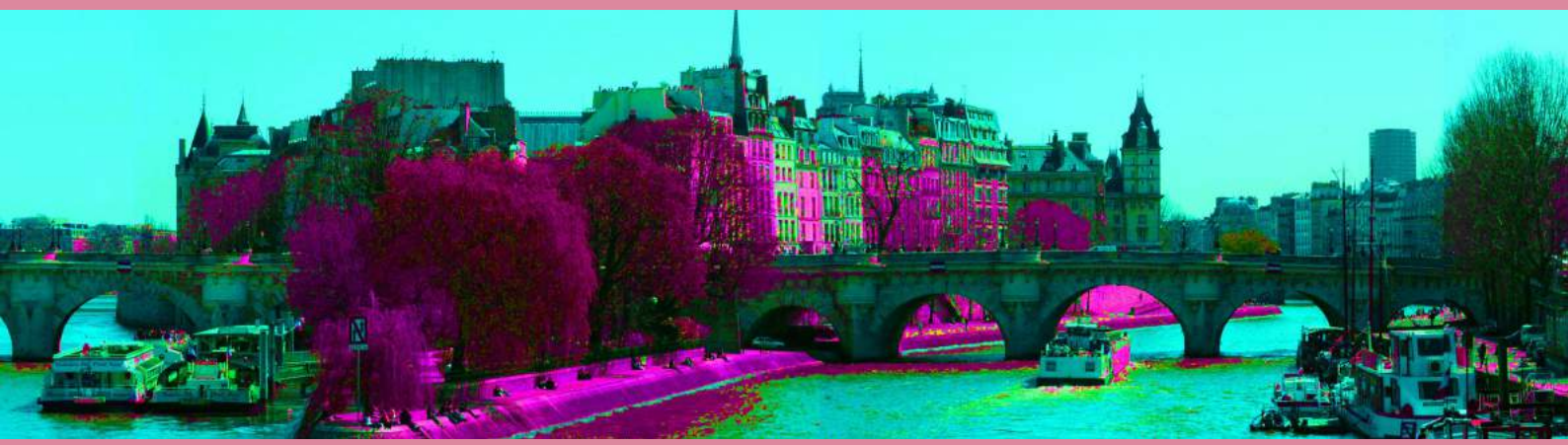

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