Biomedical Engineering



Explore this IDIL Master's track in detail, including its academic objectives, curriculum, research opportunities, admission requirements and career prospects.

TRACK OVERVIEW & LEARNING OBJECTIVES

The Biomedical Engineering Master's programme offers an interdisciplinary training experience at the interface of chemistry, biology, pharmaceutical sciences and engineering, preparing students to address major challenges in therapeutic innovation and healthcare. The programme focuses on understanding biological systems and disease mechanisms in order to design, develop, and evaluate next-generation therapeutic strategies, including biomaterials, nanomedicines, and advanced biotherapies. Particular emphasis is placed on biological therapeutics such as proteins, nucleic acid medicines, extracellular vesicles and cell-based therapies. Students will be trained to understand and engineer the interactions between molecules, cells, tissues, and materials that determine the efficacy, safety, and translation of innovative therapies.

During the first year (M1), students will acquire the scientific foundations required for therapeutic design. Courses cover medicinal chemistry, synthesis of bioactive compounds, polymers for healthcare applications, cell and molecular biology, immunology, pharmacology, toxicology, and rational drug design. Students will learn how therapeutic targets are identified, how bioactive molecules are discovered and optimized, and how biological systems respond to therapeutics. Practical laboratory training provides hands-on experience in enzymology, cellular assays, and experimental approaches commonly used in drug discovery and biomedical research.

During the second year (M2), the programme shifts towards emerging therapeutic approaches, with a strong focus on biologics and advanced biotherapies. Students explore cutting-edge topics including artificial intelligence for drug discovery, bioorthogonal chemistry, antibody-drug conjugates, nanomedicine, nucleic acid therapeutics, tissue engineering, cell therapy, and immunomodulation. Beyond conventional small molecules, the curriculum covers the design, production, delivery, and characterization of complex biological products such as proteins, RNA-based medicines, engineered cells and extracellular vesicles. Particular attention is given to delivery technologies and biomaterials that support the effective translation of these therapeutic innovations into clinical practice. Through specialized laboratory projects, students gain hands-on experience in peptide conjugation, nanoparticle engineering, bioprinting, and advanced characterization methods. Graduates will be equipped with the scientific, technical, and critical-thinking skills required for careers in biomedical research, biotechnology, pharmaceutical development, advanced therapy medicinal products (ATMPs), medical technologies, and healthcare innovation.

As part of the **IDIL Graduate Program**, this Master's programme combines advanced disciplinary training in biomedical engineering with an immersive research experience. Students follow a fully English-taught curriculum, benefit from individualized mentoring by researchers, and spend extended periods in research laboratories through *In-Lab* modules and two six-month internships. The programme encourages interdisciplinary thinking by allowing students to explore complementary fields while remaining anchored in biomedical sciences and therapeutic innovation. This direct integration into Montpellier's internationally recognized research ecosystem provides students with a unique opportunity to develop both scientific excellence and translational vision, preparing them for careers in academia, biotechnology, pharmaceutical development, advanced biotherapies, and healthcare innovation.

The **Biomedical Engineering track** aims to train the next generation of scientists and innovators capable of addressing unmet medical needs through the development of advanced therapeutic solutions. Built on a highly interdisciplinary approach that integrates biology, chemistry, pharmaceutical sciences, and engineering, the programme equips students with the scientific knowledge, technical skills, and research experience required to identify relevant therapeutic strategies. Students learn to bridge disciplines and work across traditional scientific boundaries, enabling them to tackle complex biomedical challenges and develop therapeutic strategies ranging from biomaterials to biologics, nanomedicines, and advanced biotherapies. Through its research-driven and translational approach, the programme prepares graduates for careers in biomedical research, biotechnology, pharmaceutical development, healthcare innovation, and doctoral studies.

More specifically, the programme aims to:

- Develop a comprehensive understanding of the biological and physicochemical principles governing therapeutic interventions.
- Provide expertise in the design, development, characterization, and evaluation of therapeutic agents, biomaterials, and drug delivery systems.
- Introduce emerging therapeutic modalities, including biologics, nucleic acid medicines, nanomedicines, extracellular vesicles, cell therapies, and other advanced therapy medicinal products.
- Develop the ability to integrate multidisciplinary knowledge to solve complex biomedical challenges.

Foster critical thinking, experimental autonomy, and innovation through hands-on laboratory training and research immersion.

KNOWLEDGE, SKILLS & COMPETENCIES

Graduates of the Biomedical Engineering track will acquire a unique combination of expertise spanning biology, chemistry, pharmaceutical sciences, and engineering, enabling them to contribute to the development of innovative therapeutic solutions from concept to application.

Upon completion of the programme, graduates will be able to developp expertise at different levels:

Scientific and Technical Expertise

- Understand the molecular, cellular, and physiological mechanisms underlying human diseases and therapeutic responses.
- Identify and evaluate therapeutic targets relevant to drug discovery, regenerative medicine, and advanced therapies.
- Design and optimize therapeutic strategies based on biologics, nucleic acid medicines, extracellular vesicles, biomaterials, and cell-based therapies.
- Understand the principles governing the formulation, delivery, biodistribution, efficacy, and safety of therapeutic products.
- Characterize bioactive compounds, biomaterials, and nanomedicines using physicochemical, biological, and analytical approaches.

Experimental and Research Skills

- Design and conduct experiments in chemistry, molecular and cellular biology, biomaterials science, and nanomedicine.
- Apply state-of-the-art methodologies for therapeutic development, including medicinal chemistry, bioorthogonal chemistry, nanoparticle engineering, tissue engineering, and bioprinting.
- Analyze, interpret, and critically evaluate experimental data and scientific literature.
- Develop research projects using rigorous scientific methodology and evidence-based approaches.

Innovation and Translational Skills

- Integrate multidisciplinary knowledge to address complex biomedical and healthcare challenges.
- Evaluate the translational potential of emerging therapeutic technologies and advanced therapy medicinal products (ATMPs).
- Consider regulatory, ethical, and industrial constraints throughout the development of biomedical innovations.
- Contribute to the translation of scientific discoveries into clinically relevant therapeutic solutions.

Transversal Skills

- Work in multidisciplinary and international environments.
- Communicate scientific concepts and results to both specialist and non-specialist audiences.
- Manage complex projects with autonomy, critical thinking, and problem-solving abilities.
- Adapt to rapidly evolving scientific and technological landscapes within biomedical research and innovation.

DETAILED CURRICULUM

- **Semestre 1 (S7)**
  - Personal project (10 ECTS)
  - Transversal training units IDIL (4 ECTS)
  - Non-core training unit (2ECTS)
  - In-Lab (2 ECTS)

  Core Teaching units:
  - Chemical synthesis of bioactive compounds (4ECTS)
  - Polymers for Health (2 ECTS)
  - Biological Foundations for Biomedical Engineering (4 ECTS)
  - Rational drug design of small molecules (4ECTS)

- **Semestre 2 (S8)**
  - Internship IDIL (30 ECTS)

- **Semestre 3 (S9)**
  - Multidisciplinary team project (10 ECTS)
  - Transversal units training units IDIL (4 ECTS)
  - Non-Core Training Unit (2ECTS)
  - Design of next generation therapeutics (3 ECTS)
  - Applied bio-orthogonal chemistry: probes and conjugate therapeutics (3 ECTS)
  - Translational nanomedicine : from design to clinical application (3ECTS)
  - Tissue engineering and cell therapy (2 ECTS)
  - Cell therapy & Tissue engineering 2 (2ECTS)
  - Engineering immunomodulatory therapies for Autoimmunity (3ECTS)

- **Semestre 4 (S10)**

- Internship IDIL (30 ECTS)

Non-Core :

- Why democracy is hard?
- Mediterranean Terrestrial Ecosystems
- Defusing quantitative bullshit
- Scientific openness to earth and water issues under global c
- Plant health 2.0 : a global war
- One health and eco-epidemiology
- The Bionic Man
- Explore, understand and learn
- Biology by the numbers: Measure, Predict, and Design
- Who's afraid of AI?
- Sustainable management basics
- Innovations in clinical biomarkers, biotechnologies for pers
- The Chemistry of Beer, Wine and Culinary Arts
- How the way we move reveals who we are

In-Labs :

- Cellular assays for drug discovery
- Enzymology for drug discovery
- Synthesis of bioactive peptide conjugates
- Lipid Nanoparticle formulation & characterization for nucleic acids delivery
- Polymer Nanoparticle formulation & characterization

ADMISSION REQUIREMENTS & STUDENT PROFILE

This programme is intended for students with a strong interest in biomedical innovation and therapeutic development at the interface of biology, chemistry, pharmaceutical sciences, and engineering. It is particularly suited to graduates in life sciences, chemistry, biotechnology, biomedical sciences, pharmacy, materials science, or related disciplines who wish to develop expertise in emerging healthcare technologies. The programme welcomes students seeking a research-oriented and multidisciplinary training in areas such as drug discovery, biologics, nanomedicine, biomaterials, regenerative medicine, and advanced therapeutic products, with the objective of pursuing careers in research, innovation, or further doctoral studies.

Applicants must possess:

- A Bachelor's degree (or equivalent) in chemistry, life sciences, biotechnology, biomedical sciences, engineering, or a closely related discipline.
- Fundamental knowledge of chemistry and/or biology.

- Sufficient proficiency in English to understand scientific courses and literature.

CAREER OPPORTUNITIES

The strong emphasis on research methodology, critical thinking, and experimental practice prepares students for careers in academic research, translational medicine, and biomedical innovation. Graduates may pursue PhD programmes in biomedical engineering, in pharmaceutical sciences, in nanomedicine, in biomaterials and tissue engineering, in drug discovery and medicinal chemistry, in cell and gene therapy.

Graduates will be qualified for positions in research, development, innovation, and regulatory environments across the healthcare sector. Potential career paths include research engineer, academic or compagny R&D, technology transfer officer, clinical innovation project Manager. Employment sectors include pharmaceutical industry, biotechnology companies, medical device industry, nanomedicine companies, contract research organizations (CROs), Academic and hospital research centers, Innovation and technology transfer structures

RESEARCH LABORATORIES & ACADEMIC PARTNERS

Institute of Regenerative Medicine & Biotherapies (IRMB), IHU Immun4cure, Occitanie Bioproduction Biotherpay Integrator (OBBI), Institut de Recherche en Cancérologie de Montpellier (IRCM), Institut des Biomolécules Max Mousseron (IBMM), Institut Charles Gerhardt de Montpellier (ICGM)

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