



**POLYTECH<sup>®</sup>**  
**CLERMONT-FERRAND**

GRADUATE SCHOOL OF ENGINEERING  
OF CLERMONT AUVERGNE UNIVERSITY

UNIVERSITÉ  
Clermont  
Auvergne



INTERNATIONAL PROGRAM

## MASTER LEVEL BIOLOGICAL ENGINEERING

in POLYTECH CLERMONT-FERRAND

DURATION

**1 semester**  
(Fall or Spring)  
**or 1 year**  
(October to June)

Total ECTS Credits 60

### OBJECTIVES

The aim of the Master program in biological engineering is to bring to international students the theoretical and practical background required to be in adequation with industry leaders in biological engineering.

Different formula are offered to international students: one semester (Fall or Spring, 30 ECTS) or one full year (60 ECTS).

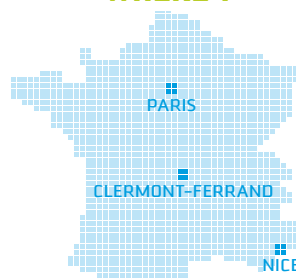
Various topics are covered: from Microbiology to Genetics, skills and knowledge are presented via practical sessions, research projects and an internship, depending of the formula chosen.

Courses will be done by highly qualified researchers recognized for their scientific and pedagogical skills, coming from various French laboratories. The master program is composed of a two-step training program, including projects and internships. The objective of projects is to reinforce the acquisition of theoretical background tackled during the practical sessions.

International students spending one year will attend to a final internship for research activity at the end of the year in addition to research projects; whereas those spending one semester only.



### WHERE ?





# MASTER LEVEL COURSE CONTENT



## FALL SEMESTER (September to December)

SCIENTIFIC COURSES 13 ECTS

### GENETIC ENGINEERING BIOINFORMATICS → 3 ECTS

Tools for sequences alignment

Techniques for cloning DNA fragment in bacterial/yeast systems

Experimental techniques of genetic engineering and molecular biology (cloning, PCR, Southern Blot)

Organize and plan an experiment

1. Construction of DNA probes of a gene of interest
2. Cloning of DNA fragments (probes) in plasmids
3. Genomic DNA Extraction
4. Enzymatic digestion with restriction enzymes
5. Probe and Molecular Hybridization (Southern)

### PLANT BIOTECHNOLOGY → 3 ECTS

Acquisition of notions in botany (major plant kingdoms), physiology of seed and plant development, plant function at the cellular level (plant hormones and cell signaling under normal culture conditions and biotic and abiotic stresses), in vitro culture, techniques of genetic transformation of plants and industrial applications.

Use and handling of plants grown in vitro, manipulation of unicellular plant organisms in association with microorganisms, concept of industrial uses of plants and properties, genetic transformations of plants.

1. Plant *in vitro* culture
2. Genetic transformation of the moss *Physcomitrella patens*
3. Application of an AFNOR Standard on plants
4. Demonstration of the action of gibberelins in barley seeds germination
5. Study of the antibacterial activity of essential oils
6. Analysis of the composition of mint essential oil
7. Plants-microorganism associations
8. Carotenoids extraction of a red algae: *Eucheuma Cottonii*

### MICROBIOLOGY → 3 ECTS

Standardized methods in microbiology for the detection of bacteria, introduction to the quality insurance (traceability)

Microorganisms at the center of biotechnology - Useful and harmful bacteria.

1. Standards to the application: standardized methods of research and enumeration of major bacteria in food hygiene
2. Use of molecular detection technologies for microorganisms
3. Constraints of work organization in microbiology: holding of a laboratory notebook, traceability

### GENETICS → 4 ECTS

Prokaryotes and eukaryotes genetics for industrial uses

Bacterial genetics: contributions / applications in terms of molecular tools and technologies that stem from knowledge of bacterial genetics.

Plant genetics: quantitative genetics, genetic breeding, segregation, molecular markers, physical map and genetic map, genetics of association, genomic selection, molecular marker generation and polymorphism study, genetics of association, optimal use of marker-assisted selection.

### BIOMOLECULE SYNTHESIS → 3 ECTS

Consolidate fundamental principles of chemistry in order to understand molecular biological processes.

Understand the constraints and the methods developed for the synthesis of bioactive molecules.

Amino acid coupling, racemic splitting, Stereospecificity of enzymatic reactions

## SPRING SEMESTER (January to June)

SCIENTIFIC COURSES 12 ECTS

### INDUSTRIAL TECHNOLOGIES → 3 ECTS

#### BIOTECHNOLOGY → 3 ECTS

Host cell systems for the production of recombinant proteins.

Acquisition of a global vision of the process from the production to the purification of recombinant proteins.

Production system in bacteria and yeast.

Developing autonomy in a lab context or

Microbiology: 3 ECTS

Production and use of microorganisms and / or enzymes in the food industry.

Separation and purification techniques

Introduction to Experimental Plans

Simulation and Modeling

### IMMUNOLOGY → 2 ECTS

Acquire the basics in immunology and immunological techniques Understanding the mechanisms involved in the immune response

Knowledge of some major known pathologies and different detection methods

1. Double immuno-diffusion (Ouchterlony)
2. Detection of antigens by the spotting method (Dot blot)
3. Study of the components of a rabbit serum by Western Blot
4. ELISA technique: BSA / anti-BSA system
5. SDS-PAGE Technology

### BIOPROCESSES AND BIOCATALYSIS → 4 ECTS

Give an overview of the nature and economic importance of current industrial biological processes.

Development of skills in the field of the application of biocatalysts (microorganisms or isolated enzymes) for the production of molecules of industrial interest.

Analysis of the constraints related to the production of molecules of biological interest. Proposed biotechnological solutions.

## FALL OR SPRING SEMESTER (September to June)

TRAINING COURSES 15-20 ECTS

### INDIVIDUAL RESEARCH PROJECTS → 10 ECTS

In relation with supervisors specialized in bioprocess engineering, genetic engineering, metabolic engineering in different Laboratories on the Cézéaux campus, the objectives of the individual research projects will be to develop innovative techniques or knowledge on a topic given by specialized companies in Food, pharmaceutical, or environmental industry.

### INTERNSHIPS IN RESEARCH LABORATORIES (2 MONTHS) → 10 ECTS

An internship is encouraged to be a unique international experience for doing research. International students will be host by Academic French Laboratories on the Cézéaux campus for a 2 month internship in the fields of Bioprocess Engineering, Food science or Environment

# ADMISSION REQUIREMENTS

Bachelor level - Resume with 240 European credits (ECTS), specialization in Biology

## ENGLISH PROFICIENCY

The minimum required is the level B1 of the Common European Framework of Reference for Languages evaluated by English tests as follow: Paper-based TOEFL score = 475, Internet-based TOEFL score = 50, TOEIC score = 550, IELTS = 4.5, Cambridge = FCE, etc.

## FRENCH PROFICIENCY

No minimum level of French is expected when entering the program. However, to pass successfully the program, it would be required, at the end of the program, to pass a French test at which a minimum score must be attained. French courses are highly recommended to be taken at the center of French learning FLEURA in Clermont-Ferrand.

## APPLICATION PROCESS AND DEADLINES

Applications will be made through the international office of the sending university for nomination. Selection of the candidates will be made by Polytech.

Deadlines to apply  
- Fall semester: 15 May  
- Spring semester: 15 October

## FOCUS ON...

### POLYTECH NETWORK

Polytech is a group of 14 public faculties dedicated to higher education, research and innovation in engineering. These institutions, under the authority of the French Ministry of Higher Education and Research, form a network of 14 French universities, sharing a unique model for their 14 faculties of engineering. All 86 different curricula of Polytech correspond to the 86 Masters in engineering degrees (Diplômes d'Ingénieur) that are accredited by CTI (Commission des Titres d'Ingénieur).

All curricula are classified into 12 different scientific fields. Polytech group includes 68 000 alumni and more than 3000 new Masters graduates every year. Geared towards industrialists and economic stakeholders, the graduates are acknowledged for their excellence at national and international level generating numerous job opportunities.

With a staff community of more than 1300 faculty-members, Polytech group supports excellence in 125 research laboratories. More than 1 000 qualified lecturers from companies in all professional sectors also contribute to taking up the challenges in engineering education of the graduate students.

### POLYTECH CLERMONT-FERRAND

Founded in 1969, Polytech Clermont-Ferrand is one of the oldest engineering universities in France. Polytech Clermont-Ferrand is a founding member of the Polytech network, and has developed its development in this context, both locally and nationally and internationally.

Key figures

- 1000 student engineers and apprentice engineers
- 6000 graduate engineers
- 6 engineering degrees
- 80 teacher-researchers faculties
- 15% of training provided by nearly 150 industrial players
- 10 associated research laboratories

Polytech Clermont-Ferrand is the Graduate School of Engineering of Clermont Auvergne University.

With six different diplomas through initial and continuing training, Biological Engineering, Civil Engineering, Electrical Engineering, Mathematical Engineering and Modeling, Engineering Physics, Production System Engineering, Polytech Clermont-Ferrand has trained nearly 6000 engineers since its inception.

The policy of partnerships with national and international entities, inscribes the school in major projects like several European projects, in close connection with the regional competitiveness clusters. Several companies have been created by young graduate engineers; The 2 000 months of internships per year in industrial environments and the abundant contracting activity of the support laboratories testify to the vitality of the school in terms of industrial and entrepreneurial relations in all its fields of training.

## CONTACT DETAILS

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