

# Description Master's in Molecular Microbiology

The Master of Science in Molecular Microbiology offers two concentrations: Bioinformatics and Molecular Diagnostic. This program provides specific training to future microbiologists in the interpretation and analysis of new generation sequences and their integration into biological knowledge. In addition, it uses sophisticated bioinformatics systems through data analysis and the use of open source platforms. It includes the study of molecular techniques in the design of diagnostic methods used for the detection of pathological conditions and the study of techniques applied to instruments that are used for research purposes.

The Master of Science in Molecular Microbiology consists of 34-35 credits. Concentration and general education and general education requirements are offered through the two-year program. Both majors have 24-25 credits of core requirements that are located throughout the five quarters. Each major has 9 credits of specialized courses. As a requirement for degree approval, all students must complete 3 credits of Research Project or Thesis. The Master's Degree in Molecular Microbiology is offered in the Spanish modality.

Professionals with a master's degree in Molecular Microbiology could be employee in the Pharmaceutical Industries, in Biotech companies, or other molecular diagnostic related companies, including the omics industry.

## Mission

The Master's in Molecular Microbiology is designed to develop students' understanding of modern concepts in Molecular Diagnostics and Bioinformatics and familiarize them with the development of advanced laboratory skills, teach them to solve scientific problems that will enable them to solve problems in our society and to face the demand for employment or doctoral studies.

## Competencies Profile of Graduates

The Program is designed to develop the professional competencies that will enable the student:

### Specialization in Bioinformatics

#### Knowledge

1. Demonstrate knowledge of microbiology in the genomic era, in aspects related to the balance of ecosystems.
2. Distinguish scientific information from various sources.
3. Distinguish the most useful platforms (pipeline) for data management in molecular microbiology.

#### Skills

1. Apply molecular microbiology methodology in scientific research aimed at solving problems.
2. Evaluate the most useful programs for data management in molecular microbiology.

3. Argue ideas and results of research, before the scientific community, orally and in writing, both in Spanish and English.

## Attitudes

1. Value the importance of ethical standards related to scientific conduct in research.
2. Recognize the importance of proposing solutions based on molecular microbiology to address situations of depredation and spoliation of ecological environments.

## Specialization in Molecular Diagnostics

### Knowledge

1. Demonstrate knowledge of microbiology in the genomic era, in aspects related to human health.
2. Distinguish scientific information from various sources.
3. Distinguish the most useful platforms (pipeline) for data management in molecular microbiology.

### Skills

1. Apply molecular microbiology methodologies in scientific research aimed at solving problems.
2. Evaluate the most useful programs for data management in molecular microbiology.
3. Argue ideas and results of research, before the scientific community, orally and in writing, both in Spanish and English.

### Attitudes

1. Value the importance of ethical standards related to scientific conduct in research.
2. Recognize the importance of proposing solutions based on molecular techniques for clinical diagnosis.

## Admission Requirements

Students, who request admission to the Master of Science in Molecular Microbiology Program, must meet the admission requisites of the current master's programs at the Institution, in addition to the following requisite:

Have passed the following courses or their equivalent, with a minimum grade of "C":

1. Genetics
2. General Microbiology
3. Cellular and Molecular Biology or Biochemistry
4. Immunology
5. Organic Chemistry I and II
6. Analytic Chemistry

\*Some of these courses require prior approval of other related courses

## REQUIREMENTS FOR THE MASTER'S IN SCIENCE IN MOLECULAR MICROBIOLOGY

Core Requirements	25-26 credits
Specialization Requirements	<u>9 credits</u>
Total	34-35 credits

### Core Requirements – 25-26 credits

Course	Title	Credits
MOMI 5101	Biochemistry of Biomolecules I	3
MOMI 5102	Biochemistry of Biomolecules II	3
MOMI 5110	Microbial Genetics	2
MOMI 5130	Biosafety	1
MOMI 5210	Microbial Physiology and Metabolism	3
MOMI 5300	Microbial Ecology	2
MOMI 5310	Microbial-Host Interactions	3
MOMI 6300	Omics Approaches in Microbiology	2
MOMI 6310	Seminar in Molecular Microbiology	1
MOMI 6400	Data Analysis and Bioinformatics	2
MOMI 6989	Research Project	3
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MOMI 6991	Thesis	2
MOMI 6992	Thesis Continuation	2

\* Students who opt for doctoral studies must take courses MOMI 6991 and 6992.

### Specialization Requisites: 9 credits

Students will select one of the two specializations: Bioinformatics or Molecular Diagnostic.

#### Specialization in Bioinformatics

Course	Title	Credits
MOMI 5320	Programming and Data Mining	3
MOMI 6320	Microbial Genomics	3
MOMI 6410	Molecular Phylogenetic	3

#### Specialization in Molecular Diagnostics

Course	Title	Credits
MOMI 6331	Recombinant DNA Techniques	3
MOMI 6332	Molecular Diagnostic Techniques in Microbiology	3
MOMI 6500	Advanced Molecular Diagnosis	3

## Listado de Cursos de Concentración Medulares

### **MOMI 5101 BIOCHEMISTRY OF BIOMOLECULES I**

Evaluation of the structure, function, metabolism, thermodynamics, expression, and interactions of nucleic acids. Emphasis on DNA biochemistry in prokaryotic systems.

**3 credits**

### **MOMI 5102 BIOCHEMISTRY OF BIOMOLECULES II**

Analysis of the biosynthesis and metabolism of carbohydrates, lipids, and proteins. Evaluation of protein purification methods as tools in the development of research. Prerequisite: MOMI 5101.

**3 credits**

### **MOMI 5110 MICROBIAL GENETICS**

Analysis of the mechanisms of exchange of genetic material between bacteria and the control of gene expression. Emphasis on the use of plasmids, transposition elements and bacteriophages as genetic tools.

**2 credits**

### **MOMI 5130 BIOSAFETY**

Analysis of health and safety regulations promulgated by FDA, OSHA, CDC, NIH, and other related entities. Recognition, evaluation, and control of risks related to the procedures and facilities in which microbiological tests and recombinant DNA are carried out.

**1 credit**

### **MOMI 5210 MICROBIAL PHYSIOLOGY AND METABOLISM**

Evaluation of the relationship between microbial structure and function with emphasis on intermediary metabolism.

Integration of physiological mechanisms. It includes cell division and growth, the response to stressors, and regulation.

**3 credits**

### **MOMI 5300 MICROBIAL ECOLOGY**

Analysis of microbial diversity at the genetic, physiological, phylogenetic, and functional levels. Application of the concepts of classical ecology to populations and microbial communities with emphasis on the evolutionary bases of biodiversity.

**2 credits**

### **MOMI 5310 MICROBIAL-HOST INTERACTIONS**

Analysis of cellular and molecular mechanisms that characterize commensal and parasitic relationships between microbe and host. Emphasis on the immune response of the host against infectious agents and how it is modulated by the components of the normal microbiota and other mechanisms involved in commensal symbiotic relationships.

**3 credits**

### **MOMI 6300 OMICS APPROACHES IN MICROBIOLOGY**

Analysis of omics disciplines in the field of microbiology. Emphasis on biotechnological applications, the use of bioinformatics and the application of automated techniques for the analysis and interpretation of a large volume of data and its contribution to the study of cellular function and microbial systems.

**2 credits**

### **MOMI 6310 SEMINAR IN MOLECULAR MICROBIOLOGY**

Critical analysis of refereed or scholarly literature relevant to molecular microbiology. Application of the scientific

methodology for the oral and written presentation of a topic selected by the student in molecular microbiology.

**1 credit**

### **MOMI 6400 DATA ANALYSIS AND BIOINFORMATICS**

Application of bioinformatics and biostatistics to the analysis of a high volume of experimental data in microbiological investigations. Emphasis on solving practical problems through the use of open-source programs. It requires 30 hours of conference-laboratory.

**2 credits**

### **MOMI 6989 RESEARCH PROJECT**

Selection and development of a research topic relevant to molecular microbiology. The students will demonstrate their capacity for interpretation and integration of theoretical concepts related to bioinformatics and molecular diagnosis. The student will enroll as many times as necessary in a consecutive academic year to complete the project. Grade: P/PP/NP.

**3 credits**

### **MOMI 6991 THESIS**

Planning, design, and preparation of the research proposal of the thesis on a topic relevant to molecular microbiology. Approval of the proposal by the thesis committee. The student will enroll as many times as necessary. Grade: P/TP/NP.

**2 credits**

### **MOMI 6991 THESIS CONTINUATION**

Development of research, collection, and analysis of results. Drafting of thesis and then its defense before the thesis committee. The results of the research are expected to be publishable. The student will

enroll as many times as necessary.

Prerequisite: MOMI 6991. Grade: P/TP/NP.

**2 credits**

## **Courses in the Specialization in Bioinformatics**

### **MOMI 5320 PROGRAMMING AND DATA MINING**

Application of open-source platforms (pipeline) for the analysis and mining of data in biological sequences. Emphasis on the analysis of DNA, RNA and protein sequences using computational tools such as Python, UNIX, and R, among others. Requires 45 hours of conference-laboratory.

**3 credits**

### **MOMI 6320 MICROBIAL GENOMICS**

Analysis of molecular organization, information, and genomic products. Emphasis on sequencing, assembly, and annotation. Description of genes in genomes and metagenomes of clinical and environmental origin. It requires 30 hours of conference-laboratory.

**3 credits**

### **MOMI 6410 MOLECULAR PHYLOGENETIC**

Application of phylogenetic methods to infer evolutionary relationships between genes or organisms. Construction of phylogenetic trees using molecular data. It requires 45 hours of conference-laboratory.

**3 credits**

## Courses in the Specialization in Molecular Diagnostics

### **MOMI 6331 RECOMBINANT DNA TECHNIQUES**

Application of the concepts of recombinant DNA technology to the cloning and expression of genes as diagnostic tools. It requires 30 hours of lecture and 45 hours of closed laboratory.

**3 credits**

### **MOMI 6332 MOLECULAR DIAGNOSTIC TECHNIQUES IN MICROBIOLOGY**

Application of molecular techniques in the detection, identification, and

characterization of microbial pathogens of clinical forensic importance. Evaluation of the automation processes of molecular techniques. It requires 30 hours of lecture and 45 hours of closed laboratory.

**3 credits**

### **MOMI 6500 MOLECULAR DIAGNOSIS**

Evaluation of the use of biological markers and the evaluation of methods for the molecular diagnosis of infectious diseases. Identification of the ethical and legal aspects of the privacy of genetic information.

**3 credits**