UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2021/22
MASTER DEGREE
QUANTITATIVE BIOLOGY (Classe LM-8)
Enrolled from 2020/2021 academic year

HEADING	
Degree classification - Denomination and code:	LM-8 Industrial biotechnologies
Degree title:	Dottore Magistrale
Length of course:	2 years
Credits required for admission:	180
Total number of credits required to complete programme:	120
Years of course currently available:	1st , 2nd
Access procedures:	Open, subject to completion of self-assessment test prior to enrolment
Course code:	F5B

PERSONS/ROLES

Head of Study Programme

Prof. Marco Nardini (marco.nardini@unimi.it)

Tutors - Faculty

(name.surname@unimi.it)

Academic guidance tutor: Prof. Anna Moroni
Master's degree admission tutor: Prof. Anna Moroni, Michele Mazzanti
Internship tutor: Prof. Giuseppina Caretti
Study plan tutor: Dr. Matteo Brilli
Erasmus and international mobility tutor: Prof. Marco Buscaglia

Degree Course website

http://qbio.cdl.unimi.it

http://www.unimi.it/en/education/faculties-and-schools/science-and-technology/industrial-biotechnology

https://www.unimi.it/en/education/quantitative-biology

Academic Services Office

Milan - Via Celoria, 26 (presently by email only) Email: biotecindamb@unimi.it

International Students Office

Milan - Via S. Sofia, 9/1 https://www.unimi.it/en/node/359/ Email: international.students@unimi.it

Student administrative office

Milan - Via Celoria, 18 Phone 0250325032 https://www.unimi.it/en/node/360 https://www.unimi.it/en/node/359

CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

The Master's degree course in Quantitative biology (QB) prepares graduates in biological and biotechnological disciplines to operate at the intersection between biology and physics. The quantitative approach requires a physical understanding of biological phenomena and the development of mathematical and computational tools for the analysis, understanding, and redesign of biological systems. The aim is to train a new generation of experts with integrated skills in biology, chemistry, physics, mathematics and computer science, able to perform accurate experimental measurements and apply predictive theoretical models, to explain biological complexity. Quantitative biology uses emerging technological and computational capabilities to model biological processes for biotechnological applications such as protein and metabolic engineering, drug discovery and synthetic biology. It is therefore proposed a path that includes training activities aimed at acquiring in-depth knowledge of:

(a) biochemical and biophysical aspects of cellular processes and molecular interactions;

(b) experimental methodologies for the study and measurement of these processes;

(c) analytical techniques and protocols used in structural biology and molecular and cellular biophysics studies;

(e) technical bases of modelling in systems biology for the study of interactions in complex biological systems;

(f) linear algebra, matrix calculus and its use in the description of dynamic biological phenomena and to understand the basis of artificial intelligence (machine learning);

(g) Python programming language and its use for statistical data analysis;

(h) formal logic elements

Characteristic and related mandatory teachings (72 CFU, of which 6 CFU with guided choice) include teachings on quantitative aspects of the main molecular and cellular biological disciplines, teachings on chemistry involving spectroscopy and its applications in biology; aspects of statistical analysis of data and errors, measurements of nanoscale interactions between biomolecules, programming elements in Python and machine learning aspects, linear and matrix algebra, description of dynamic systems using differential equations.

In addition, 12 CFU will be freely chosen by the students from among all the teachings activated by the University of Milan, provided they are consistent with the training project and 3 CFU for other activities (Italian language skills for foreigner students or seminars and orientation to the world of work).

Finally, the course includes, as a qualifying moment of training and acquisition of skills, an experimental thesis lasting at least 33 CFU. The Thesis Internship must be carried out in research laboratories of the University of Milan or in other public or private institutions, national or foreign, after approval, and provides for the production of a written thesis, in which the original results of the research are reported.

Expected learning outcomes

1. Knowledge and understanding
Master graduates in "Quantitative Biology" will apply biomolecular-cellular, mathematical, chemical and physical instruments to understand and describe complex and dynamic biological systems. Students will be guided in the generation of predictive models, simulations and their experimental analysis and verification.

2. Applying knowledge and understanding
A fundamental objective of the Master's Degree in "Quantitative Biology" is the constant experimental practice of the theoretical knowledge acquired. This will be achieved both through the teaching classes, that will include a hands-on part of laboratory practice and through the dissertation work, which has been reserved the large part of CFU (33) in the second year of the course. The experimental project carried out as part of the dissertation work will be instrumental to increase the students' ability to apply their acquired knowledge.

3. Autonomy/judgment (Making judgments)
To foster the acquisition of autonomous judgment by the students, teaching classes will discuss recent issues and "hot topics" in their subject and will include a problem-solving approach. Through reading and discussing teaching material and research papers, students will be stimulated to evaluate notions and information critically.

4. Communication skills
The students will improve their communication skills in teaching classes, which will include activities such as journal clubs, seminars, etc., as well as in their experimental project leading to their dissertation, which will include oral presentation and discussion of their results and writing their dissertation work in English.

5. Learning skills
The students will develop their ability to understand, discuss, and transfer the taught subjects in the English language, and their ability to access and organize databases and other information on the net. The quality of the teaching classes and the time devoted to the experimental project leading to the dissertation will allow the students to learn through "hands-on" approach and the constant interaction both with their peers and the instructors.

Professional profile and employment opportunities

The Master's degree in Quantitative Biology provides employment opportunities in research institutes and industry in the areas of bio-nano-technologies, bio-pharmaceutical research, and in the development of high-tech research instrumentation.

- Primary duties of a graduate in QB can range from analyze and optimize pre/clinical trials and predict outcomes using modeling and simulation, integration and interpretation of data from many sources to help drive project decisions, apply molecular modeling and computer aided drug design techniques, basic use and maintenance of laboratory instrumentation, literature review.

- Skills: Autonomy, precision, ability to synthesize, problem solving through modeling and simulation, goal-orientation and excellent predisposition to work in team, good/excellent level of written and spoken English, good direct intervention capacity on the instrumentation on both, the hardware and the software of the instrument.

- The graduate in QB can be hired as junior research scientist, product scientist, junior research project manager, scientific application specialist, scientific equipment services specialist.

EXPERIENCE OF STUDY ABROAD AS PART OF THE TRAINING PROGRAM

The University of Milan supports international mobility by providing its students with the opportunity to spend study and internship periods abroad. It is a unique chance to enrich your educational path in a new exciting environment.
The agreements entered into by the University with over 300 universities from the 27 EU member countries and other Extra-EU countries under the European Erasmus+ programme allow regularly enrolled students to carry out part of their studies at one of the partner universities or to undertake internships at companies, training and research centres and other organizations.
Similar international mobility opportunities are provided outside Europe, through agreements with a number of prestigious institutions.

Study and internships abroad

The QB degree program supports the international mobility of the University program: professor Marco Buscaglia (for the academic year 2021/2022) acts as a tutor for students interested in the Erasmus + program, in order to guide students in their choice of the most suitable program for their formation. Every January, the Erasmus + program is presented to the QB students through a local event organized by the coordinator of the Erasmus + program of the Industrial Biotechnology area (Prof. Veronica Gregis).
In the framework of the Erasmus+ program, the QB Master course has in place agreements with Universities in Denmark, Germany, Spain, France, Norway, and The Netherlands, all offering courses in English. Calls for participation can be found at the following link: https://www.unimi.it/en/international/study-abroad/studying-abroad-erasmus.
The time spent abroad can be used to attend courses and pass the relative exams, thus collecting credits towards the Master degree, as well as to carry out the experimental project for the dissertation. The student admitted to the mobility program must submit a study plan detailing the training activities that he/she plans to carry out, with the corresponding credits. The number of credits should correspond as much as possible to the number of credits that the student should acquire in a similar time at the home University. The proposed activities must be consistent with the goals and the contents of the Master degree. The study plan must be approved by the QB Student Mobility Committee, which can request changes or integrations. At the end of the mobility program, according to the guidelines provided by the University of Milan, the courses attended (with a passed exam) by the student are registered in his/her career, preferably with its original name and with an indication of the ECTS (European Credit Transfer and Accumulation System) and their conversion in CFU (usually
1 ECTS= 1 CFU). The students willing to carry out their dissertation work as part of a mobility program abroad must have an internal supervisor (chosen among the QB lecturers) and the study plan must be approved by the QB teaching board.

How to participate in Erasmus mobility programs

The students of the University of Milan can participate in mobility programmes, through a public selection procedure.
Ad hoc commissions will evaluate:
• Academic career
• the candidate's proposed study programme abroad
• his/her foreign language proficiency
• the reasons behind his/her application

Call for applications and informative meetings
The public selection generally begins around February each year with the publication of a call for applications specifying the destinations, with the respective programme duration (from 2/3 to 12 months), requirements and online application deadline.

Every year, before the deadline for the call, the University organizes informative meetings to illustrate opportunities and rules for participation to students.

Erasmus+ scholarship
The European Union grants the winners of the Erasmus+ programme selection a scholarship to contribute to their mobility costs, which is supplemented by the University funding for disadvantaged students.

Language courses
Students who pass the selections for mobility programmes can benefit from intensive foreign language courses offered each year by the University.

Learn more at https://www.unimi.it/en/international/study-abroad/studying-abroad-erasmus

For assistance, please contact:

International Mobility Office
Via Santa Sofia 9 (second floor)
Tel. 02 503 13501-12589-13495-13502
Contacts: InformaStudenti mobility.out@unimi.it
Student Desk booking through InformaStudenti

1st COURSE YEAR Core/compulsory courses/activities common

Learning activity	Ects	Sector
Advanced molecular biology	9	(9) BIO/11, (9) BIO/18
Cell biophysics	6	(6) BIO/09, (6) BIO/04
Integrated structural biology	6	BIO/10
Mathematical modeling for Biology	6	(6) MAT/09, (6) MAT/05, (6) MAT/06, (6) MAT/07, (6) MAT/08
Measurement of nanoscale interactions in biological systems and data analysis	6	(6) FIS/03, (6) FIS/02, (6) FIS/01
Molecular biophysics	6	FIS/07
Principle of spectroscopy and applications to quantitative biology	10	(10) CHIM/01, (10) CHIM/03, (10) CHIM/02, (10) CHIM/06
Programming in Python	6	INF/01
Total compulsory credits	55	

2nd COURSE YEAR Core/compulsory courses/activities common

Learning activity	Ects	Sector
Imaging in living cells	5	(5) FIS/07, (5) BIO/04
Introduction to Logic	6	M-FIL/02
Total compulsory credits	11	

Further elective courses

The student must choose one of the following courses:

Cell population dynamics	6	(6) BIO/06, (6) BIO/17, (6) BIO/13
Non linear dynamics in quantitative biology	6	(6) BIO/11, (6) BIO/19, (6) BIO/18
Structural bioinformatics	6	FIS/07

Open choice courses: 12 CFU

End of course requirements

Other training activities		3	ND
Thesis project and final dissertation		33	ND
	Total compulsory credits	36	