



**UNIVERSITA' DEGLI STUDI DI MILANO**  
**PROGRAMME DESCRIPTION - ACADEMIC YEAR 2025/26**  
**IN**  
**QUANTITATIVE BIOLOGY (Classe LM-8)**  
**Enrolled from 2020/2021 to 2024/2025 academic year**

### **HEADING**

<b>Degree classification - Denomination and code:</b>	LM-8
<b>Degree title:</b>	Dottore Magistrale
<b>Length of course:</b>	2 years
<b>Credits required for admission:</b>	180
<b>Total number of credits required to complete programme:</b>	120
<b>Course years currently available:</b>	2nd
<b>Access procedures:</b>	open, subject to entry requirements
<b>Course code:</b>	F5B

### **PERSONS/ROLES**

#### **Head of Study Programme**

Prof. Carlo Camilloni

#### **Degree Course Coordinator**

Prof.ssa Anna Moroni

#### **Tutors - Faculty**

Academic guidance advisors - Thomas Vaccari and Marco Buscaglia

Erasmus and International Mobility advisor - Veronica Gregis

Erasmus Traineeship advisor - Federica Marini

Study plan advisor - Matteo Brilli

Internship advisor and Thesis advisors - Anna Moroni

Master's Degree admission advisor - Anna Moroni and Matteo Brilli

Educational Credit (CFU) recognition - Anna Moroni

#### **Degree Course website**

<http://qbio.cdl.unimi.it>

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

#### **Academic Services Office**

Milan - Via Celoria, 26 Tel. 0250314870 By appointment. <https://informastudenti.unimi.it/saw/ess?AUTH=SAML>

#### **Boards**

Anna Moroni, Matteo Brilli (Master's degree admission); Marco Buscaglia (Student Mobility); Matteo Brilli (Study Plan).

#### **Disability manager**

Matteo Chiara

#### **International Students Office**

Milan - Via S. Sofia, 9/1 <https://www.unimi.it/en/international/coming-abroad/international-students-office-welcome-desk>

#### **Student administrative office**

Milan - Via Celoria, 18 Tel. 0250325032 The front offices receive in the days and times indicated on the following webpage: <https://www.unimi.it/en/study/student-services/welcome-desk-informastudenti/student-desks-locations-and-opening-hours>

### **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;
- (d) technical bases of modelling in systems biology for the study of interactions in complex biological systems;
- (e) linear algebra, matrix calculus and its use in the description of dynamic biological phenomena and to understand the basis of artificial intelligence (machine learning);
- (f) Python programming language and its use for statistical data analysis;
- (g) 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 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 analyse and optimize pre/clinical trials and predict outcomes using modelling and simulation, integration and interpretation of data from many sources to help drive project decisions, apply molecular modelling and computer aided drug design techniques, basic use and maintenance of laboratory instrumentation, literature review.

- Skills: Autonomy, precision, ability to synthesize, problem solving through modelling 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, bio-nanotechnologist, junior research project manager, scientific application specialist, scientific equipment services specialist.

### **Pre-requisites for admission**

Students willing to enroll in the Master Course in Quantitative Biology must possess the following requirements:

1. Bachelor or University Degree obtained with a three-year course, or equivalent title obtained abroad.
2. Minimum English requirements
3. Adequate personal background, evaluated during the entry interview

#### 1. Bachelor's Degree

Italian or foreign citizens with a Bachelor's degree (Italian Laurea Triennale or equivalent) in Biotechnology (L-2 class and previous class 1) and Biological Sciences (L-13 class) can apply and will be admitted by default to the entry interview (comma 2).

Italian or foreign citizens with a Bachelor's degree (Italian Laurea Triennale or equivalent) in the following classes:

- Chemical sciences and technologies (L27 class)
- Physical sciences and technologies (L30 class);
- Mathematical sciences (L35 class)
- Food Science and Technology (L26 class);
- Pharmaceutical science and technology (L29 class)
- Agriculture and forestry industry (L25 class)

can apply and will be admitted to the entry interview ON CONDITION that they have acquired at least 12 University credits (ECTS, European Credit Transfer System or CFU, Crediti Formativi Universitari), in the following subjects: Biochemistry, Molecular biology, Cell Biology and/or Cell Physiology (SSD BIO/10, BIO/11, BIO/06). If the candidate does not have the above curricular requirements, her/his knowledge will be evaluated during the Entry interview.

#### 2. Language Requirements

Knowledge of English (B2 level) is a requirement for the access to the QB master's degree. Students should have acquired beforehand a B2 level certification (vantage or upper intermediate, as defined by the Common European Framework of Reference for Languages: Learning, Teaching, Assessment). Students without a B2 level certification may be accepted on condition that their level of English proficiency, assessed during the interview, is evidently good.

#### 3. Adequate personal background: Entry interview

The adequate personal background of the candidates and their ability to communicate in English are decisive elements for the acceptance to QB and they are going to be verified and tested during an Entry interview. Knowledge of Italian is not required. Particular attention will be given to the knowledge in biological subjects of candidates with non-biological backgrounds. In this case, the Entry interview will identify gaps requiring extra study to be levelled off by the student with the support of tutors before the official start of the Academic year.

### **Programme structure**

- Teaching organization and delivery mode

The QB Master degree is a 2-year course, each year is divided in two terms (semesters). The Master Course includes frontal lectures, practical classes, and an experimental research project leading to the final dissertation. 120 educational credits (CFU, Crediti Formativi Universitari) are required to complete the Master's degree. A CFU corresponds to a standard student workload of 25 hours, and it is calculated as follows:

- for frontal lectures, 1 CFU= 8 hours of lectures and 17 hours of personal elaboration;
- for practical classes, 1 CFU= 16 hours of laboratory activities and 9 hours of personal elaboration;
- for thesis internship, 1 CFU= 25 hours of laboratory and/or training activities.

- Courses (84 CFU), subdivided into:

Compulsory courses (66 CFU)

Mathematical modelling for Biology

Programming in Python

Cell Biophysics

Measurement of nanoscale interactions in biological systems and data analysis

Principle of spectroscopy and applications to quantitative biology  
Advanced molecular biology  
Integrated structural biology  
Molecular biophysics  
Imaging in living cells  
Introduction to Logic

Elective courses (6 CFU):

Non-linear dynamics in quantitative biology  
Structural bioinformatics  
Cell population dynamics

Free choice courses (12 CFU)

Single Courses offered by others MSc, consistent with QB educational plan

Other activities (3 CFU)

Italian language skills for foreigner students, seminars, short lab internships, and other orientation activities to the job market.

Experimental thesis (33 CFU)

The Thesis Internship must be carried out in research laboratories of the University of Milan or, upon approval, in other public or private institutions, national or foreigner. The experimental thesis internship lasts at least 9 months (33 CFU) and requires the writing of a final dissertation, reporting the results of an original research project.

- Conscientious objection policy

In the QB Master degree, the use of animals for teaching purposes is not allowed as stated by the law: art. 5f of the Legislative Decree 26/2014. Such procedures are allowed during the traineeships for thesis preparation. However, they must be carried out exclusively by authorized staff, since, in this case, the Legislative Decree 26/2014 does not apply. According to Italian law n. 413, October 12 1993, "Norme sull'obiezione di coscienza alla sperimentazione animale", students have the incontestable right to conscientiously object to participation in any experimental activity using animals. In this case, the Teaching Board will suggest alternative traineeships, that are consistent with the educational goals of the QB course, to ensure the correct acquisition of the study credits necessary for degree completion.

- Study plan submission

Students will present a "Study plan", indicating the choice of elective and free courses, at the end of the first semester (first year). The Study plan must be approved by a Study Plan Committee, composed of QB lecturers. The Study plan can be changed upon request; however, it represents the official record of the degree and the list of courses must correspond to the exams passed by the student in order to grant admission to the final dissertation.

In addition, students are invited to consider the activities included in the University project for the development of soft skills: <https://www.unimi.it/en/study/bachelor-and-master-study/following-your-programme-study/soft-skills>

If interested, the soft skills courses must be included in the study plan, they are of compulsory attendance, they have a defined number of places and they can only be selected by the students if they have been subscribed by the Master's degree program to which students belong. <https://qbio.cdl.unimi.it/en/courses>

- Schedule of teaching activities

The first Semester starts on October 1st, 2025 and ends on January 16th, 2026.

The second Semester starts on March 2nd, 2026 and ends on June 12th, 2026.

Lesson timetables are available at the URL:

<https://easystaff.divisi.unimi.it/PortaleStudenti/>

or by downloading the official student Class timetable app of the University of Milan "Lezioniunimi"

- Exams

Each course is followed by an exam, usually a written or an oral test (or a combination). Credits for a course are only granted upon passing the corresponding exam. Courses can be taught by more than one instructor: in this case, only one lecturer will be responsible for the final assessment of the student.

- Exam sessions and assesment methods

Exam sessions are scheduled during a lecture break at the end of each term. For each course, at least 6 exam sessions are scheduled per academic year. Exams in Italian universities are typically graded on a scale that goes from zero to thirty points. The minimum score to pass an exam (and be awarded the respective credits) is 18, and the maximum is 30 e lode (from the Latin expression cum laude, "with distinction"). If failed, the exam can be repeated. Also, the exam can be repeated to improve the grade. Pre-enrollment for the exam is mandatory and occurs through the UNIMIA online service (available at <https://qbio.cdl.unimi.it/en/study/exams>).

## **Campus**

Lecture rooms and laboratories are in the campus “Città Studi”, in the University buildings of Via Celoria, 26 (Edificio Biologici); Via Celoria, 20 (Settore Didattico); Via Golgi, 19 (Edificio Golgi). The course of Logic (Department of Philosophy) is held in the University headquarter, via Festa del Perdono 7. The Department of Biosciences is the reference structure for all teaching activities related to the QB course.

## **Libraries**

The main scientific library is “Biblioteca di biologia, informatica, chimica e fisica” (campus "Città Studi", Via Celoria 18). See: <http://www.sba.unimi.it/en/libraries/13453.html>

## **Tutoring**

Tutors will provide students with academic advice, guidance on their course choices and personal advice. They will be available for one-to-one meetings with the students. For the academic year 2024/2025 students can contact Professors Anna Moroni, Matteo Brilli, Thomas Vaccari and Marco Buscaglia at their standard institutional e-mail addresses (name.surname@unimi.it). Students that need tutoring may also contact the secretary's e-mail address: [biotecindamb@unimi.it](mailto:biotecindamb@unimi.it)

## **Compulsory attendance**

Attendance to lectures and practical courses is mandatory. Training activities related to the Master thesis are certified by the Supervisor.

## **Internship criteria**

The experimental thesis accounts for 33 CFU and represents a major part of the Master degree program. Thesis internship: the student will carry out an original experimental project in a research laboratory during an internship of, at least, 9 months (33 cfu). The thesis project can be performed either in a laboratory at the University of Milan or in another research laboratory, upon previous authorization of the Coordinator of the Master degree. At the end of the internship, the Student will write a dissertation in English, that will be approved by an internal tutor (relatore interno) before public defense. The dissertation will describe the original research or project carried out by the student and its subject must be consistent with the goals and the disciplines taught in the Master degree.

## **Degree programme final exam**

The final exam consists of the oral presentation and discussion of the main results of the thesis project in front of a dissertation committee and it contributes with a maximum of 10 points to the final grade. The final grade will be thus assigned as the weighted average of the grades in the lecture courses, calculated on a scale of 110, to which the points of the final dissertation will be added. The 120 CFU required to take the final test for the achievement of the master's degree are acquired, in compliance with these regulatory rules.

## ***EXPERIENCE OF STUDY ABROAD AS PART OF THE DEGREE 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 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: QB lecturers (for the academic year 2024/2025, Veronica Gregis and Marco Buscaglia) act as tutors for students interested in the Erasmus + program, 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 Germany, Spain, France, Norway, and The Netherlands, all offering courses in English.

Calls for participation to Erasmus Studio 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's degree, as well as to carry out the experimental project for the dissertation. Students admitted to the mobility program must submit a study plan detailing the training activities that they plan 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's 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 record, 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 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 for Erasmus+ mobility for study generally begins around February each year with the publication of a call for applications specifying destinations and requirements. Regarding the Erasmus+ Mobility for Traineeship, the University of Milan usually publishes two calls a year enabling students to choose a destination defined by an inter-institutional agreement or to find a traineeship position on their own.

The University organizes informative meetings to illustrate mobility opportunities and rules for participation.

Erasmus+ scholarship

The European Union grants the winners of the Erasmus+ programme selection a scholarship to contribute to their mobility costs, which may be 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 Language Centre (SLAM).

<https://www.unimi.it/en/node/8/>

Learn more at <https://www.unimi.it/en/node/274/>

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](mailto:mobility.out@unimi.it)

Student Desk booking through InformaStudenti

## ADMISSION CRITERIA: 1ST YEAR OPEN, SUBJECT TO ENTRY REQUIREMENTS

N° of places reserved to non-EU students resident abroad

20

<b>1st COURSE YEAR (Cancelled since academic year 2025/26) Core/compulsory courses/activities</b>				
Scheduling	Learning activity	Module/teaching unit	Ects	Sector
	Principle of spectroscopy and applications to quantitative biology		10	(2) CHIM/01, (1) CHIM/03, (2) CHIM/02, (5) CHIM/06
	Cell biophysics		6	(5) BIO/09, (1) BIO/04
	Mathematical modeling for Biology		6	(2) MAT/09, (1) MAT/05, (1) MAT/06, (1) MAT/07, (1) MAT/08
	Measurement of nanoscale interactions in biological systems and data analysis		6	(4) FIS/03, (1) FIS/02, (1) FIS/01
	Programming in Python		6	INF/01
	Advanced molecular biology		9	(6) BIO/11, (3) BIO/18
	Integrated structural biology		6	BIO/10
	Molecular biophysics		6	FIS/07
Total number of compulsory credits/ects			55	
<b>2nd COURSE YEAR Core/compulsory courses/activities</b>				
Scheduling	Learning activity	Module/teaching unit	Ects	Sector
1 semester	Imaging in living cells		5	(2) FIS/07, (3) BIO/04
1 semester	Introduction to Logic		6	M-FIL/02
Total number of compulsory credits/ects			11	

<b><i>Elective courses</i></b>				
<b>The student must choose one of the following courses:</b>				
1 semester	Non linear dynamics in quantitative biology		6	(1) BIO/11, (4) BIO/19, (1) BIO/18
1 semester	Structural bioinformatics		6	FIS/07
2 semester	Cell population dynamics		6	(1) BIO/06, (1) BIO/17, (4) BIO/13
<b>Open choice courses: 12 CFU</b>				
<b><i>End of course requirements</i></b>				
year	Other training activities		3	NN
year	Thesis project and final dissertation		33	NN
			Total number of compulsory credits/ects	36