



UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2024/25
MASTER DEGREE
Pharmaceutical Biotechnology (Classe LM-9)
enrolled from 2024/25 academic year

HEADING

| | |
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| Degree classification - Denomination and code: | LM-9 Pharmaceutical, veterinary and medical biotechnologies |
| Degree title: | Dottore Magistrale |
| Curricula currently available: | Development and production of biotechnological drugs / PHARMACOGENOMICS AND PRECISION THERAPEUTICS / Research and development of biotechnological drugs / Biotechnological drugs in precision therapy |
| 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 |
| Access procedures: | Open, subject to entry requirements |
| Course code: | E51 |

PERSONS/ROLES

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Degree Course website

<https://biotecnologiafarmaco.cdl.unimi.it/it>

Course management for the Department of Pharmacological and Biomolecular Sciences

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Student Desks

Via Celoria 18, Milano Phone 02 503 25032 <https://www.unimi.it/it/node/360> <https://www.unimi.it/it/node/359>

Tutor for students assistance

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CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

The master degree program in Pharmaceutical Biotechnology aims to prepare graduates who have advanced skills in the development and application of new scientific methodologies, who are able to actively participate in national and international study and research projects, and who possess in-depth skills in the scientific and technical-productive aspects of biotechnology applied to human health with particular reference to the design and engineering of innovative biotechnological drugs. The master degree program in Pharmaceutical Biotechnology is structured into four curricula. A first

curriculum is aimed at providing in-depth skills in the scientific aspects of biotechnological drug design and design, characterization of their molecular and cellular mechanisms and therapeutic potential. A second curriculum provides in-depth knowledge of biotechnology drug development and production and provides notions for the organization and management of biotechnology enterprises. A third curriculum develops aspects related to the use of biotechnology drugs in precision therapy, starting from the physio-pathological context, strategy and design to manufacturing and formulation. The three curricula include common specialized teachings (first semester of the first year), which are necessary to broaden and deepen the basic skills acquired during the undergraduate degree, and characterizing teachings aimed at deepening the specificities of the curriculum, which are separated starting from the second semester of the first year and in the first semester of the second year. A fourth curriculum is delivered in English and provides preparation for future challenges in the field of the most innovative biotechnology drugs. The curriculum includes teachings in common biotechnology and pharmaceutical disciplines, which are necessary to expand the basic skills acquired during the undergraduate degree, and specialized teachings that include omics approaches, nanotechnology, and cell therapies. For all curricula, the second semester of the second year is devoted to conducting the internship at facilities of the University or other public or private institutions or companies.

Master degree graduates in Pharmaceutical Biotechnology must:

- know in-depth biochemistry and genetics of prokaryotes and eukaryotes and cell culture techniques;
- master knowledge of the structure, functions and analysis of biological macromolecules, as well as structure-activity relationships, in order to understand the mechanisms of cellular processes in which they are involved;
- possess sound knowledge of the morphology and functions of human organisms;
- know the basics of disease processes of relevance to humans, with particular emphasis on cellular and molecular pathogenic mechanisms;
- know congenital or acquired pathological situations for which to design biotechnological therapeutic approaches;
- know the fundamentals and principles for the use of the main methodologies of molecular and cellular biotechnology, with special reference to biotechnological drug design and production;
- know and be able to use techniques and technologies of molecular modeling, and design of innovative drugs;
- master bio-informatics methodologies to organize, build and access genomics, proteomics and metabolomics databases, and to acquire and distribute related scientific and technological information;
- possess skills for the analysis and quality control of biotechnological drugs, diagnostics, and vaccines;
- know the basic aspects of the operational processes that follow the industrial design of biotechnological products (including gene therapy and cell therapy), and biotechnological drug formulation;
- possess basic knowledge related to the establishment, organization and management of enterprises, management of innovation projects (including patenting new biotechnological products), and marketing activities of biotechnological pharmaceuticals and cosmetics.

Expected learning outcomes

Knowledge and understanding

The following learning outcomes will be achieved through the teachings provided in the degree program in Pharmaceutical Biotechnology:

- thorough knowledge of biochemical and genetic aspects of cells of prokaryotes and eukaryotes and of cell culture and genome editing techniques, including large-scale
- solid knowledge of the structure, functions and analysis of biological macromolecules and the cellular processes in which they are involved, and being able to understand the relationships between structure and biological activity
- thorough knowledge of biological and genetic aspects of model organisms and gene manipulation techniques
- knowledge of cellular and molecular technologies for regulating gene expression
- knowledge of the morphology and functions of human organisms
- knowledge of the fundamentals of disease processes of human interest, with reference to cellular and molecular pathogenic mechanisms
- knowledge of congenital or acquired pathological situations in which it is possible to intervene with a biotechnological approach
- knowledge related to the most innovative strategies aimed at biotechnological drug design and development
- knowledge related to advanced analytical methods in the field of biotechnological drug and biomarker research and development
- knowledge on the identification and validation of disease biomarkers suitable for the evaluation of the efficacy of biotechnological drugs
- knowledge of mechanism of action, therapeutic uses and toxicity of biotechnological drugs
- knowledge of basic aspects of operational processes for industrial production of biotechnology products (including for gene therapy and cell therapy), biopharmaceutical aspects, and basic requirements for biotechnology drug formulation
- basic regulatory knowledge necessary to develop and bring biotechnology drugs to the market, including patent aspects of biotechnological pharmaceuticals and cosmetics

This knowledge will be acquired through lectures, classroom exercises, seminars and extra-curricular activities, and group work.

The acquisition of knowledge will be verified through assignments in written and oral form, in itinere tests, oral and/or written exams.

Ability to apply knowledge and understanding

Upon completion of the training, the following skills will be acquired:

- know how to use biochemical, genetic and cellular knowledge of prokaryotes and eukaryotes applicable to molecular and cellular biotechnology in the design and production of biotechnological drugs
- know and be able to use the main methodologies that characterize molecular and cellular biotechnology also for the purpose of biotechnological drug design and production
- possess skills for the application of cellular and animal models for the study of communicable and noncommunicable diseases
- know and be able to use specific techniques and technologies in areas such as molecular modeling, design, and preparation of innovative drugs
- have mastery of bio-informatics methodologies for the purposes of organizing, building and accessing databases, particularly genomics, proteomics and metabolomics, and acquiring and distributing scientific and technological information
- possess skills for the analysis and quality control of biotechnological drugs, diagnostics, and vaccines
- ability to identify critical issues in a manufacturing process and propose an appropriate control strategy in order to meet the requirements of regulatory agencies

The skills described above will be acquired through lectures, group work, classroom exercises, and through activities carried out in person by students such as exercises in computer and biological and chemical laboratories and the internship activities.

Acquired skills will be assessed through assignments in written and oral form, laboratory report writing, oral and/or written examinations, and thesis writing.

Autonomy of judgment

- critical evaluation of the quality and interpretation of studies and papers related to red biotech (biotechnology applied to pharmaceuticals)
- critical evaluation of experimental/clinical design and validation approaches of potential biotech/biologic drugs and their targets;
- critical evaluation of experimental/clinical identification and validation approaches of diagnostic and prognostic markers

Autonomy of judgment will be acquired through group or individual work, journal clubs provided in various teaching activities, computer, biological and chemical laboratory activities, and experimental activity during internship.

Acquisition of autonomy of judgment will be assessed through assignments in written and oral form, laboratory reports, examination in written and/or oral form, writing of the thesis paper.

Communication skills

- communication skills in oral and written form in Italian and/or English on topics related to biotechnology drugs and advanced therapies.
- proficient use of new information technologies related to communication.
- ability for effective communication with red biotech specialists, medical personnel, other professionals involved in biotechnology, and the general public.

Communication skills will be acquired through the preparation of oral presentations, laboratory reports, assignments, journal clubs scheduled in the various teaching activities, thesis writing and presentation to the graduate committee.

Acquisition of communication skills will be tested through assignments in written and oral form, laboratory reports, examination in written and/or oral form, thesis writing and presentation of the same to the graduate committee.

Learning skills

The graduate in Biotechnology of Pharmaceuticals should be able to independently manage the ways of acquiring new knowledge, not only through the understanding of scientific articles in English and bibliographic consultations, but especially through the consultation of inclusive databases of genomics, proteomics, metabolomics and chemistry data, as well as other networked information, as part of formal courses and internship activities. In addition, master's degree graduates in Pharmaceutical Biotechnology will develop skills to enable the independent set-up and execution of studies and research relevant to the most distinctive areas of study in pharmaceutical biotechnology but also related areas of research.

- ability to continue their own scientific and professional growth through the use of appropriate and referenced sources of information
- ability to contribute to the development and application of new approaches in the red biotech sector (academia, public and private research institutions, companies, national and international regulatory agencies).
- development of skills in management, team working and project management and in writing and presenting projects and reports aimed at research activities. Formattato: Tipo di carattere: GrassettoFormattato: Tipo di carattere: GrassettoFormattato: Tipo di carattere: GrassettoFormattato: Tipo di carattere: Grassetto

Learning skills will be acquired through the application of knowledge learned in the various courses and through the activities

Learning skills will be acquired through the application of knowledge learned in the various courses and through the activities carried out in them (lectures, classroom exercises, seminars and extra-curricular activities, group work). In particular, data processing and data interpretation during the practical application internship will represent the activities in which students will be able to implement and develop their learning ability.

Learning ability will be assessed through assignments in written and oral form, laboratory reports, and examinations in written and/or oral form. In addition, learning ability will be ascertained by testing the ability to apply knowledge acquired

in the various teachings (and associated activities) to the writing of the thesis paper and its presentation to the graduation committee. The graduation committee will assess the extent to which students have acquired the ability to learn.

Professional profile and employment opportunities

Researcher in public and private universities and research centers

Function in a work setting:

design and execution of scientific experiments, analysis and processing of data, preparation of scientific reports, presentation of results in national and international arena.

Skills associated with the function:

inventive ability, autonomy in experiment execution, critical sense in data evaluation, ability to work in a team, ability to write research projects, ability in scientific communication in Italian and English.

Career opportunities:

Subject to passing the relevant competitive examinations, professional opportunities are possible at public and private universities, CNR, Istituto Superiore di Sanità, IRCCS and by passing appropriate selections in universities and international research institutions.

Researcher in Industry (Research and Development Sector)

Function in a work setting: identification of new targets, design of model compounds and optimization, development of appropriate models for in vitro and in vivo compound evaluation, data analysis and processing, preparation of scientific reports.

Skills associated with the function:

inventive ability, planning skills, autonomy, critical sense in data evaluation, ability to work in a team and interface with other professionals.

Career opportunities:

Subject to passing appropriate selections, professional opportunities are possible in the biotechnology, pharmaceutical, diagnostic, food and cosmetics industries.

Operator in Industry (Production Sector)

Function in a work setting:

management activities in production, management activities in quality control, management activities in formulation.

Skills associated with the function:

management skills, planning skills, ability to interface with other professionals.

Career opportunities:

biotechnology, pharmaceutical, diagnostic, food and cosmetics industries.

Worker in Industry (Marketing Sector)

Function in a work setting:

dissemination of scientific study results to health or business professionals, marketing activities, technical consulting.

Skills associated with the function:

interpersonal skills, scientific communication skills.

Career opportunities:

biotechnology, pharmaceutical, diagnostic, food, and cosmetics industries.

Clinical monitor and activities in the area of pharmacovigilance

Function in a work setting:

supervision and monitoring of clinical protocols, supervision and management of drug safety reports

Skills associated with the function:

Ability to interface with other professionals in industry and hospital settings.

Career opportunities:

pharmaceutical industry and Clinical Research Organizations (CROs).

Operator in industry and national and international ministerial/governmental agencies (Sector Regulatory)

Function in a work setting:

drafting and evaluation of manufacturing and marketing authorization documentation and post-authorization amendments

Skills associated with the function:

knowledge of national legislation and international regulations related to biotechnology drugs; ability to analyze and prepare documentation for manufacturing and marketing authorization and post-authorization changes

Career opportunities:

Pharmaceutical industry, national and international regulatory agencies, regulatory bodies.

Operator in science dissemination through conventional and new media

Function in a work context:

Preparation of dissemination material of a technical-scientific nature on issues related to biotechnology and its use for the protection of human health.

Skills associated with the function:

communication and dissemination skills towards a generalist audience; knowledge of conventional and new media.

Career opportunities:

news agencies, newspaper editorial offices, freelancer.

The course allows to obtain the qualification to the profession of biologist.

Initial knowledge required

Admission requirements

The following candidates are eligible for the Master's degree programme in Pharmaceutical Biotechnology:

- Graduates of class L-2, as well as the corresponding classes pursuant to Ministerial Decree 509/99;
- Graduates of other classes, provided they meet the following requirements:
 - at least 9 academic credits (CFU) across the following subject areas (SSD): CHIM/01, CHIM/03 and/or CHIM/06;
 - at least 12 academic credits (CFU) across the following subject areas (SSD): BIO/10, BIO/11 and/or BIO/13;
 - at least 6 academic credits (CFU) in the following subject area: (SSD): BIO/14;
 - at least 6 academic credits (CFU) across the following subject areas (SSD): BIO/09, BIO/16 and/or MED/04;
- Holders of a qualification obtained abroad and recognized as suitable who prove that they have acquired the same level of knowledge and skills in biology, chemistry, biochemistry, molecular biology, pharmacology, anatomy, pathology and physiology, as specified above.

Admission assessment

In addition to curricular requirements, admission to the programme is subject to an assessment test. Curricular requirements will be assessed by an admissions board appointed by the Academic Board and composed of at least three faculty members supported by the teaching secretariat, based on the candidate's previous academic records, and possibly an interview. The curricular assessment will ascertain the level of knowledge (credits earned and grade achieved) in the following subjects: general and inorganic chemistry (CHIM/03), analytical chemistry (CHIM/01) and organic chemistry (CHIM/06); biochemistry (BIO/10), molecular biology (BIO/11) and biology (BIO/13); pharmacology (BIO/14); anatomy (BIO/16), physiology (BIO/09) and pathology (MED/04). Please note that the knowledge of the aforementioned disciplines may also have been achieved by attending single courses.

The interview, if any, may be held in person (in the classrooms of the Department of Pharmacological and Biomolecular Sciences, Via Balzaretti 9, Milan) or online.

Upcoming graduates are also eligible for the interview.

The dates, time and place of in-person interviews will be posted to the degree programme website: <https://biotecnologiafarmaco.cdl.unimi.it/en>

The interview dates will be agreed by e-mail with individual candidates.

Language skills

Proficiency in English at a B2 level or higher per the Common European Framework of Reference for Languages (CEFR) is required for admission.

The B2-level requirement will be ascertained by the University Language Centre (SLAM) upon admission as follows:

- Language certificate of B2 or higher level issued no more than three years before the date of admission application. You will find the list of language certificates recognized by the University at: <https://www.unimi.it/en/node/297/>). The certificate must be uploaded when submitting the online application;
- English level achieved during a University of Milan degree programme and certified by the University Language Centre (SLAM) no more than four years before the date of admission application. In this case the process is automatic, the applicant does not have to attach any certificates to the application;
- Placement test administered by the University Language Centre (SLAM) according to the calendar published on the website: <https://www.unimi.it/en/node/39267/>

All those who fail to submit a valid certificate or do not meet the required proficiency level will be instructed during the admission procedure to take the placement test.

Applicants who do not take or pass the placement test will be required to obtain a language proficiency certificate recognized by the University (see: <https://www.unimi.it/en/node/297/>) and deliver it to the SLAM via the InformaStudenti service by the deadline fixed for the master's programme: 31 October 2024 (<https://www.unimi.it/en/node/39267/>).

Applicants who do not meet the requirement by said deadline will not be admitted to the master's degree programme and may not sit any further tests.

In case of transfer from another degree programme or from another university, the procedures for admission to years subsequent to Year I will be set out by the Academic Board.

For further details, see the section: "How to enrol".

Compulsory attendance

Attendance is compulsory for teaching laboratories, and strongly recommended for all lectures.

Internship criteria

You can undertake your thesis internship at the University or other public or private institutions or companies. During your

second year, you will be required to attend an interdisciplinary laboratory covering theoretical and practical biotechnology skills. You can apply for your thesis internship starting from the second semester of the 1st year of the programme, provided you have earned at least 30 academic credits (ECTS). To start your thesis internship, you must have earned 56 academic credits (ECTS).

Upcoming graduates are required to fill out the internship completion form and submit it to their supervisor, who will validate it and send it to the Student Registrar. If you wish to undertake your thesis internship at an external research institution, you must first identify an academic tutor from among the faculty of Pharmacy, who will ensure that you achieve the required learning objectives. Then you can submit your application with your thesis project attached to the Academic Board for approval. This also applies to thesis internships at other universities.

Internships at external research institutions and companies are governed by agreements with COSP. You will have to start a procedure through a dedicated platform. Learn more at <https://www.unimi.it/en/node/483/>

Degree programme final exams

Upcoming graduates must pass a final exam by presenting and defending a written paper on their internship. The paper may be in Italian or English. The final paper completes the student's training as part of the Master's degree programme.

The degree boards will assess the student's entire course of study and, in particular, the consistency between learning objectives and professional goals, as well as cultural, intellectual and oral skills.

Campus

Course venue: Città Studi teaching facilities

Laboratories

The degree programme is laboratory-intensive. Laboratory courses are compulsory and must be attended in the relevant year. During laboratory practicals, students will learn the rules of safe behaviour.

Notes

Admission criteria: 1st year open, subject to entry requirements

All students must submit the online admission application for the admission by the following deadlines: Italian students and students from EU Countries: from January 22nd, 2024 to August 25th, 2024.

Students from extra-EU Countries must complete the admission application online from January 22nd, 2024 to April 30, 2024, in order to facilitate the necessary procedure for issuing visas by the competent Authorities. Non-EU candidates admitted to the master programme must pre-enroll on Universitaly (<https://www.universitaly.it/first-steps>) by July 31, 2024. Undergraduates who intend to obtain the Bachelor degree graduate by October 31, 2024 may also apply.

Full details on curricular requirements and personal background can be found in the "Initial knowledge required" section.

Enrolment

At the end of the evaluation procedures, candidates admitted and already in possession of the Bachelor degree will have to matriculate online by November 30, 2024.

For procedures: <https://www.unimi.it/en/study/bachelor-and-master-study/degree-programme-enrolment/enrolment-masters-programme/open-admission-master-programmes>

N° of positions reserved to non-EU students resident abroad: 35

Study plan definition and submission for approval

The student must provide an individual study plan indicating the elective course units for a total of 9 credits. These will be chosen freely among all courses provided by the University of Milan if they are consistent with the educational project, after consulting the Study Programme committee. As alternative, the student can also choose the Experimental Laboratory of Biotechnology (9 ECTS). This laboratory aims to deepen the theoretical and practical aspects of the research topic of the thesis and it will be agreed with the thesis tutor.

The study plan must be submitted online in the 1st Year, within the deadline set by the Student Desk. For information on dates and procedures for submitting the official study plan, please visit the relevant section of the UNIMI website available at <https://biotecnologiafarmaco.cdl.unimi.it/en/study/study-plan-submission> and <https://www.unimi.it/en/node/122/>.

In addition, activities included in the University project for the development of soft skills can be chosen. The educational activities must be included in the study plan, have a compulsory attendance, a limited number of places and are selectable by the student(s) only if they have been subscribed to by Course of Study. For more details, please refer to the following webpage: <https://www.unimi.it/en/study/bachelor-and-master-study/following-your-programme-study/soft-skills>. Please, note that the correspondence between the last approved study plan and the exams taken is a necessary condition for admission to the final graduation. In the event that, at the time of submitting the graduation application, the career is not coherent with the study plan, the student cannot be admitted to the graduation examination.

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 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

To increase internationalization, students will be informed on the Erasmus and Erasmus Mundus programs activated within the master course. Lectures of foreign teachers and stages in foreign laboratories will be also proposed. Some of the classes will be given in English to give the students the opportunity to improve the English knowledge, with specific focus on scientific terminology.

More info is available at the link:

<https://www.unimi.it/en/node/273>

<https://www.unimi.it/en/node/12879>

Procedure for the recognition of study periods abroad: each student must propose a Learning Agreement regarding training activities that lead to the recognition of a number of credits adequate to the period spent abroad. Specifically, 20 CFU for a three-month period; 30 CFU for a six-month period; 45 CFU for a nine-month period.

Evaluation of the period spent abroad: the period of study abroad will be recognized as valid after obtaining at least 70% of the credits specified in the learning agreement, while the activity of the thesis or internship will be valid only after acquisition of all credits.

Incentives: for students who have accomplished satisfactorily the training program, additional points are added to the final degree mark. Up to a maximum of 3 points can be added depending on the duration of the study period, the amount of credits attained, and the overall results obtained by the student.

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

Student Desk booking through InformaStudenti

ACTIVE CURRICULA LIST

Development and production of biotechnological drugs Course years currently available: 1st

PHARMACOGENOMICS AND PRECISION THERAPEUTICS Course years currently available: 1st

Research and development of biotechnological drugs Course years currently available: 1st

Biotechnological drugs in precision therapy Course years currently available: 1st

Procedure for choosing a curriculum

The choice among the four offered curricula must be done at admission. It is possible to change the curriculum only among the three held in Italian, and only before the end of the first semester.

CURRICULUM: [E51-D] Development and production of biotechnological drugs**Qualifying Training Objectives**

The curriculum provides in-depth knowledge of biotechnology drug development and manufacturing and teaches notions for the organization and management of biotechnology enterprises.

1st COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Development and production of biotechnological drugs

| Learning activity | Ects | Sector |
|--|------|--------------------------|
| Biology of development and differentiation | 6 | BIO/13 |
| Biotechnological drugs in therapy | 8 | BIO/14 |
| Clinical Pharmacology and Applied Biochemistry | 9 | (4) BIO/10, (5) BIO/14 |
| Integrated Systems Physiology | 6 | BIO/09 |
| Metabolic and Functional Biochemistry | 6 | BIO/10 |
| MOLECULAR VIROLOGY | 6 | BIO/19 |
| Organ Pathophysiology | 6 | MED/04 |
| Preparation and development of drugs with biotechnological methods | 9 | (4) CHIM/11, (5) CHIM/08 |
| Purification and formulation of biotechnological drug products | 8 | (4) CHIM/09, (4) CHIM/08 |
| Total compulsory credits | | 64 |

2nd COURSE YEAR (available as of academic year 2025/26) Core/compulsory courses/activities Curriculum-specific features Development and production of biotechnological drugs

| Learning activity | Ects | Sector |
|---|------|--------------------------------------|
| Production, legislation and marketing of biotechnological medicines | 7 | CHIM/09 |
| Quality control and analysis for biopharmaceuticals | 9 | (3) CHIM/06, (3) BIO/14, (3) CHIM/08 |
| Total compulsory credits | | 16 |

Further elective courses Curriculum-specific features Development and production of biotechnological drugs

By the deadline for submission of the study plan, the student must proceed to indicate the choice teachings for a total of 9 ETCS. These will be chosen freely a) among all the teachings proposed by the University as long as they are consistent with the study plan, after hearing the opinion of Interdepartmental Teaching Board of the master program; b) among all the teachings in the curricula not selected by the student. The student may also choose 9 ETCS of Experimental Biotechnology Laboratory. This laboratory aims to deepen the theoretical and practical aspects of the research topic that is the subject of the experimental laboratory work, and the program will be agreed with the supervisor consistently with the thesis topic. In addition, activities included in the University project for the development of soft skills are noted. The study plan will be submitted for evaluation and approval by the Interdepartmental Teaching Board of the master program.

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| Experimental laboratory of Biotechnology | 9 | ND |
|--|---|----|

End of course requirements Curriculum-specific features Development and production of biotechnological drugs

| | | |
|--------------------------|----|----|
| FINAL EXAM | 21 | ND |
| Lab training | 10 | ND |
| Total compulsory credits | | 31 |

CURRICULUM: [E51-E] PHARMACOGENOMICS AND PRECISION THERAPEUTICS**Qualifying Training Objectives**

The curriculum is delivered in English and prepares for future challenges in the field of the most innovative biotechnological drugs. It includes teachings in fundamental biotechnology and pharmaceutical disciplines, necessary to expand the basic skills acquired during the undergraduate degree, and specialized teachings including omics approaches, nanotechnology, and cell therapies.

1st COURSE YEAR Core/compulsory courses/activities Curriculum-specific features PHARMACOGENOMICS AND PRECISION THERAPEUTICS

| Learning activity | Ects | Sector |
|---|------|--------------------------------------|
| Bioinformatics and molecular modeling | 8 | (3) BIO/10, (2) CHIM/06, (3) CHIM/08 |
| Communicable and non-communicable diseases | 8 | (6) MED/04, (2) BIO/19 |
| Integrated systems physiology | 6 | BIO/09 |
| Molecular biochemistry and functional biology | 10 | (5) BIO/10, (5) BIO/13 |
| Omics: from bench to bedside | 6 | (2) MED/04, (4) |

| | | |
|---|--------------------------|--------------------------------------|
| | | BIO/10 |
| Pharmacogenomics, clinical pharmacology, and orphan drugs | 7 | BIO/14 |
| Protein engineering, drug delivery and regulatory aspects | 11 | (7) CHIM/09, (4) CHIM/08 |
| | Total compulsory credits | 56 |
| 2nd COURSE YEAR (available as of academic year 2025/26) Core/compulsory courses/activities Curriculum-specific features PHARMACOGENOMICS AND PRECISION THERAPEUTICS | | |
| Learning activity | Ects | Sector |
| Biomarkers: from identification to exploitation | 10 | (4) MED/13, (3) BIO/14, (3) CHIM/08 |
| Cell therapy and gene silencing | 7 | (2) BIO/19, (2) BIO/14, (3) BIO/13 |
| Nanotechnology based medicinal products | 7 | (2) BIO/14, (2) CHIM/06, (3) CHIM/09 |
| | Total compulsory credits | 24 |
| Further elective courses Curriculum-specific features PHARMACOGENOMICS AND PRECISION THERAPEUTICS | | |
| By the deadline for submission of the study plan, the student must proceed to indicate the choice teachings for a total of 9 ETCS. These will be chosen freely a) among all the teachings proposed by the University as long as they are consistent with the study plan, after hearing the opinion of Interdepartmental Teaching Board of the master program; b) among all the teachings in the curricula not selected by the student. The student may also choose 9 ETCS of Experimental Biotechnology Laboratory. This laboratory aims to deepen the theoretical and practical aspects of the research topic that is the subject of the experimental laboratory work, and the program will be agreed with the supervisor consistently with the thesis topic. In addition, activities included in the University project for the development of soft skills are noted. The study plan will be submitted for evaluation and approval by the Interdepartmental Teaching Board of the master program. | | |
| Experimental Laboratory of Biotechnology | 9 | ND |
| End of course requirements Curriculum-specific features PHARMACOGENOMICS AND PRECISION THERAPEUTICS | | |
| Final Exam | 21 | ND |
| Lab Training | 10 | ND |
| | Total compulsory credits | 31 |

CURRICULUM: [E51-F] Research and development of biotechnological drugs

Qualifying Training Objectives

The curriculum is aimed at providing in-depth expertise in the scientific aspects of biotechnology drug design and engineering, characterization of their molecular and cellular mechanisms, and their therapeutic potential.

| | | |
|---|--------------------------|--------------------------------------|
| 1st COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Research and development of biotechnological drugs | | |
| Learning activity | Ects | Sector |
| Biology of development and differentiation | 6 | BIO/13 |
| Biotechnology in Pharmacology | 8 | (6) BIO/14, (2) BIO/13 |
| Design, development, and therapeutic application of biotechnological drugs | 9 | (3) CHIM/06, (3) BIO/14, (3) CHIM/08 |
| Integrated Systems Physiology | 6 | BIO/09 |
| Metabolic and Functional Biochemistry | 6 | BIO/10 |
| MOLECULAR VIROLOGY | 6 | BIO/19 |
| Omics approaches: from research to therapy | 6 | (3) BIO/10, (3) BIO/14 |
| Organ Pathophysiology | 6 | MED/04 |
| Structural Bioinformatics and Molecular Modeling | 10 | (4) BIO/10, (3) CHIM/06, (3) CHIM/08 |
| | Total compulsory credits | 63 |
| 2nd COURSE YEAR (available as of academic year 2025/26) Core/compulsory courses/activities Curriculum-specific features Research and development of biotechnological drugs | | |
| Learning activity | Ects | Sector |
| Analytical and formulation strategies in biotechnological drug discovery | 8 | (4) CHIM/09, (4) CHIM/08 |
| Pharmacogenomics and biomarkers | 9 | (2) MED/13, (7) BIO/14 |
| | Total compulsory credits | 17 |
| Further elective courses Curriculum-specific features Research and development of biotechnological drugs | | |

By the deadline for submission of the study plan, the student must proceed to indicate the choice teachings for a total of 9 ETCS. These will be chosen freely a) among all the teachings proposed by the University as long as they are consistent with the study plan, after hearing the opinion of Interdepartmental Teaching Board of the master program; b) among all the teachings in the curricula not selected by the student. The student may also choose 9 ETCS of Experimental Biotechnology Laboratory. This laboratory aims to deepen the theoretical and practical aspects of the research topic that is the subject of the experimental laboratory work, and the program will be agreed with the supervisor consistently with the thesis topic. In addition, activities included in the University project for the development of soft skills are noted. The study plan will be submitted for evaluation and approval by the Interdepartmental Teaching Board of the master program.

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|---|----|----|
| Experimental laboratory of Biotechnology | 9 | ND |
| End of course requirements Curriculum-specific features Research and development of biotechnological drugs | | |
| FINAL EXAM | 21 | ND |
| Lab training | 10 | ND |
| Total compulsory credits | 31 | |

CURRICULUM: [E51-G] Biotechnological drugs in precision therapy

Qualifying Training Objectives

The curriculum aims to develop aspects related to the use of biotechnological drugs in precision therapy, starting from the physio-pathological context, strategy and design to manufacturing and formulation.

1st COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Biotechnological drugs in precision therapy

| Learning activity | Ects | Sector |
|--|------|-------------------------------------|
| Biochemical, biomolecular, and chemical approaches for manipulating biological systems | 7 | (2) BIO/10, (2) CHIM/06, (3) BIO/13 |
| Biology of development and differentiation | 6 | BIO/13 |
| Design and optimization of monoclonal antibodies | 9 | (3) BIO/10, (3) BIO/14, (3) BIO/13 |
| Integrated Systems Physiology | 6 | BIO/09 |
| Metabolic and Functional Biochemistry | 6 | BIO/10 |
| MOLECULAR VIROLOGY | 6 | BIO/19 |
| Nanoparticles and viral vectors | 7 | (3) BIO/19, (2) FIS/07, (2) CHIM/08 |
| Organ Pathophysiology | 6 | MED/04 |
| Precision pharmacology and gender therapy | 11 | (3) MED/13, (8) BIO/14 |
| Total compulsory credits | 64 | |

2nd COURSE YEAR (available as of academic year 2025/26) Core/compulsory courses/activities Curriculum-specific features Biotechnological drugs in precision therapy

| Learning activity | Ects | Sector |
|--|------|------------------------|
| Advanced therapy medicinal products | 9 | (2) BIO/19, (7) BIO/14 |
| Formulation and legislation of monoclonal antibodies, nanovectors, and advanced therapy medicinal products | 7 | CHIM/09 |
| Total compulsory credits | 16 | |

Further elective courses Curriculum-specific features Biotechnological drugs in precision therapy

By the deadline for submission of the study plan, the student must proceed to indicate the choice teachings for a total of 9 ETCS. These will be chosen freely a) among all the teachings proposed by the University as long as they are consistent with the study plan, after hearing the opinion of Interdepartmental Teaching Board of the master program; b) among all the teachings in the curricula not selected by the student. The student may also choose 9 ETCS of Experimental Biotechnology Laboratory. This laboratory aims to deepen the theoretical and practical aspects of the research topic that is the subject of the experimental laboratory work, and the program will be agreed with the supervisor consistently with the thesis topic. In addition, activities included in the University project for the development of soft skills are noted. The study plan will be submitted for evaluation and approval by the Interdepartmental Teaching Board of the master program.

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|--|----|----|
| Experimental laboratory of Biotechnology | 9 | ND |
| End of course requirements Curriculum-specific features Biotechnological drugs in precision therapy | | |
| FINAL EXAM | 21 | ND |
| Lab training | 10 | ND |
| Total compulsory credits | 31 | |