# UNIVERSITA' DEGLI STUDI DI MILANO
# PROGRAMME DESCRIPTION - ACADEMIC YEAR 2023/24
# BACHELOR
# Biotechnology (Class L-2)
# enrolled from 2019/20 academic year

| *HEADING* | |
|---|---|
| **Degree classification - Denomination and code:** | L-2 Biotechnologies |
| **Degree title:** | Dottore |
| **Curricula currently available:** | Agrifood biotechnology / Comparative animal biotechnology / Pharmaceutical biotechnology / Molecular biotechnology and bioinformatics |
| **Length of course:** | 3 years |
| **Total number of credits required to complete programme:** | 180 |
| **Years of course currently available:** | 1st , 2nd , 3rd |
| **Access procedures:** | Cap on student, student selection based on entrance test |
| **Course code:** | K06 |

## *PERSONS/ROLES*

**Head of Interdepartmental Study Programme**
Prof. Angelo Poletti

**Tutors - Faculty**
Tutor per l'orientamento
(gli studenti dovranno farvi riferimento in base al cognome)
A-C Dr. Fabio Forlani
D-F Prof.ssa Gabriella Tedeschi
G-L Prof. Paolo Landini
M-O Prof.ssa Elena Crotti
Q-S Prof. Maurizio Crestani
T-U Prof.ssa Maria Antonietta Vanoni
V-Z Prof. Luigi Sironi

Tutor per la mobilità internazionale e l'Erasmus
Dr. Fabio Forlani
Prof. Alessio Scarafoni

Tutor per i piani di studio
Prof.ssa Marina Camera
Prof.ssa Paola Casati
Prof.ssa Daniela Maggioni
Dr.ssa Lisa Vallone

Tutor per stage e tirocini
Prof.ssa Sara Borin
Prof.ssa Gabriella Consonni
Prof. Lucio Conti
Prof.ssa Mariarita Galbiati
Prof.ssa Gabriella Tedeschi

Tutor per trasferimenti/riconoscimento crediti
Prof. Alberto Alzati
Prof.ssa Marina Camera
Prof.ssa Paola Casati
Prof.ssa Daniela Maggioni
Dr.ssa Lisa Vallone

Tutor per laboratori e altre attività
Prof.ssa Raffaella Gandolfi

Dr.ssa Chiara Magni
Prof.ssa Paola Rusmini
Prof.ssa Gabriella Tedeschi

**Degree Course website**
https://biotecnologia.cdl.unimi.it/it

**Academic Committee: Prof.Marina Camera (Chair), Prof. Alberto Alzati, Prof. Paola Casati, Prof. Daniela Maggioni, Dr. Lisa Vallone**

Ricevimento studenti - Previo appuntamento c/o Segreteria Didattica Interdipartimentale Scienze del Farmaco e Biotecnologia, Via Golgi n. 19 Email: marina.camera@unimi.it

**Biotechnology Academic Office**

via Golgi 19 - Edificio 1, ingresso D - 20133 MILANO lun, merc, ven 9:30-11:30; mar e gio 13:30-15:30
https://informastudenti.unimi.it/saw/ess?AUTH=SAML https://informastudenti.unimi.it/saw/ess?AUTH=SAML

**Erasmus tutor: Prof. Alessio Scarafoni**

Via Celoria 2, Milano Phone 02503 16820 Ricevimento studenti: libero c/o palazzina ex DISMA, 1° piano
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**Representative for disability services and specific learning disabilities (SLD): Prof. Elena Crotti**

Via Mangiagalli 25, Milano Phone 02503 19122 Ricevimento studenti: su appuntamento c/o DeFENS, via Mangiagalli 25, Milano - stanza 3023 Email: elena.crotti@unimi.it

**Student registrar**

Via Celoria 18, Milano Phone 02503 25032 https://www.unimi.it/it/node/360 https://www.unimi.it/it/node/359

## *CHARACTERISTICS OF DEGREE PROGRAMME*

**General and specific learning objectives**

The Degree Course in Biotechnology aims to provide bachelor students with solid basic knowledge and practical skills in the different fields of biotechnology. The course will favour interdisciplinary approaches and propose the study of most of the modern molecular biotechnologies used in the agro-food, environmental, industrial, pharmaceutical and veterinary fields. Notions in bioethics, patenting and legislation, fundraising and management will be also provided. Innovation is the driving force of this course; being biotechnology an area of fast and active development, continuous and efficient updating is necessary to keep continuously updated with the rapid increase in scientific knowledge.

**Expected learning outcomes**

At the end of the three years course, the graduated students must achieve basic knowledge and understanding of mathematics, physics, chemistry, general biology, cellular and molecular biology of prokaryotic and eukaryotic organisms, genetics, microbiology and biochemistry, as well as some skills of management and bioethical aspects.
The acquisition of this basic knowledge allows, in the following three semesters, the deepening of skills specific for the agro-food biotechnology, comparative animal biotechnology, pharmaceutical and molecular bioinformatics biotechnology es. Therefore, methods and applications in the biotechnological field of prokaryotic and eukaryotic organisms, isolated cells and biological macromolecules with the integrated tools of cellular and molecular biology, biochemistry, bioinformatics, genetics and microbiology for the development and implementation of biotechnological methods and processes will be acquired.
The Biotechnology graduate will also acquire knowledge that will enable him to perform assistance and support functions for research and development in the various fields of biotechnology.

**Professional profile and employment opportunities**

Biotechnology graduates will be able to work in numerous professional contexts including: the agri-food industry, the animal feed and plant production sector, the pharmaceutical industry, the chemical industry, the cosmetic industry and scientific information, the industry and services for environmental biotechnology, in reproductive biotechnology laboratories both in the medical and veterinary fields, biotechnological service centers for the applications of information technology to genomics and proteomics, universities and research laboratories of public and private institutions, certification bodies, structures of the National Health System, health regulatory agencies and national and international agencies for patent regulations for the exploitation of biotechnological products, including study centers for toxicological and environmental detection.
The specific roles and professions of the graduate in Biotechnology, based on the nomenclature and classification drawn up by ISTAT (2012), are identified by the following codes:
- Biochemical laboratory technicians
- Food technicians
- Agronomist and forestry technicians
- Veterinary laboratory technicians
- Zootechnicians

The degree course allows you to qualify for the following regulated professions:

- Agricultural biotechnologist (Agri-food curriculum)
- Junior biologist
- Medical-scientific informant (Pharmaceutical curriculum)
- The "Ordine dei Consulenti in Proprietà Industriale" (Italian Industrial Property Consultants Institute)

**Initial knowledge required**

Admission requirements

Admission to the degree programme in Biotechnology is capped pursuant to Law no. 264 of 2 August 1999. Applicants must hold an upper secondary-school diploma or equivalent foreign qualification pursuant to Ministerial Decree no. 270 of 22 October 2004.

Candidates will be required to sit an admission test aimed at ascertaining their educational background and aptitude.

Admission assessment

The test required for admission to the degree programme in Biotechnology is TOLC-S, an online test delivered by the Consortium of Inter-University Integrated Access Systems (CISIA - https://www.cisiaonline.it/), which must be taken before enrolment.

The TOLC-S test is made up of four sections, with questions on Basic Mathematics, Reasoning and Problem Solving, Reading and Comprehension, and Basic Sciences, requiring a level of knowledge and skills as provided by an upper secondary school education.

Test structure and topics: https://www.cisiaonline.it/en/area-tematica-tolc-scienze/struttura-della-prova-e-syllabus/.

The TOLC test includes an additional English section. The score in this section is a self-assessment tool and does not affect the merit ranking, nor does it replace the for-credit assessment of English language proficiency required by the degree programme (see the language assessment section).

You may sit the TOLC-S at the University of Milan or any other venue among those listed in the test calendar available at https://tolc.cisiaonline.it/calendario.php.

Registration procedures and deadlines will be provided in the call for applications posted to the University website at https://biotecnologia.cdl.unimi.it/it/iscriversi.

Only students placing themselves high enough in the merit ranking will be eligible for enrolment in the degree programme in Biotechnology.

Additional learning requirements (OFA) and remedial activities

Students who have not achieved at least 11 points in the basic mathematics module of TOLC-S will be required to fulfil additional learning requirements (OFA). Students with additional learning requirements will have to carry out remedial activities organised by the University in the period between October-December, and then take a test to prove they have filled the gaps in their knowledge. Students may not sit any second-year exams before passing the compulsory Mathematics exam.

Learn more at https://biotecnologia.cdl.unimi.it/it/studiare/le-matricole.

Admission of transfer or graduate students

Transfer students from a degree programme of the University of Milan, or another university, and graduate students will be waived from the test requirements only if admitted to years subsequent to Year I. To this end, they will have to submit a specific request for prior assessment of their academic records using the online service as shown in the call for applications. These candidates must provide a full transcript of records (listing exams, subject areas, credits, grades) and attach the course syllabi. For more details, please refer to the call for applications.

**Compulsory attendance**

Attendance is mandatory for laboratory courses.

**Internship criteria**

Students must complete an internship at the University or other public or private institution. As part of the internship, they will be required to attend an interdisciplinary theoretical and practical biotechnology laboratory in Year III. The Interdepartmental Academic Board requires students to earn at least 90 CFU before applying for an internship, and 115 CFU before starting the internship. Learn more at https://biotecnologia.cdl.unimi.it/it/studiare/laurearsi. Internship activities usually include: experimental laboratory or field activities, with data processing; monitoring of production activities or processes, with data collection and processing, including information from specific databases. For off-campus internships at University-affiliated institutions, activities must be agreed both with the supervisor (academic tutor) and the company tutor, in compliance with the timeline set out in the agreement between the University and the institution. At the end of the internship, the supervisor will certify its completion, and generate the certificate that will allow the student to earn CFU.

**Degree programme final exams**

Upcoming graduates must pass a final oral examination before a board of faculty members and possibly external experts, known as a dissertation defense. The dissertation, covering internship activities, may be written in Italian or English under the guidance of an academic supervisor, who will appoint a colleague from the faculty or an external expert as co-supervisor. In awarding credits for the final exam, the board will assess both the quality of the paper, its presentation and defense. The final dissertation completes the student's training as part of the three-year programme. It must be original work in line with the number of credits established by academic regulations. As decided by the Academic Board and posted on the website (https://biotecnologia.cdl.unimi.it/it), the degree board will assign a score based on the supervisor's assessment of the

internship, the final paper and its presentation (5 points), as well as their assessment of the candidate's cultural, intellectual and oral skills (3 points). The degree mark will reflect the student's academic records (weighted average of exam grades plus one point for on-track students, and one or two points for any successfully completed ERASMUS programmes), as well as the score assigned by the supervisor and the degree board.

**Campus**

Course venue: Città Studi teaching facilities

**Laboratories**

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

**Notes**

In order to obtain their degree, students must be proficient in English at a B1 level under the Common European Framework of Reference for Languages (CEFR). This proficiency level may be certified as follows:
- By submitting a language certificate attesting B1 or higher level in English and issued no more than three years before the date of submission. 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 during the enrolment procedure, or subsequently to the portal http://studente.unimi.it/uploadCertificazioniLingue;
- By taking a placement test offered by the University Language Centre (SLAM) between October and December of the first year (or in January for single-cycle programmes). Students who fail the test will be required to take a SLAM course.
The placement test is mandatory for all those who do not hold a valid certificate attesting to B1, B2, or higher level.
Those who have not taken the placement test by the end of December (end of January for single-cycle programmes) or fail the end-of-course exam six times must obtain the necessary certification privately before graduating.

## *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**

The study opportunities within the ERASMUS + Program, the specific participation rules and the selection criteria for students are described in the announcements that the University generally publishes in January, and are illustrated during specific meetings advertised on the Degree Course and the University websites. Agreements have been signed with several universities, distributed throughout Europe (for a total of 13 countries), mainly in Spain, Germany, France, Holland, Belgium and the United Kingdom, selected on the basis of didactic and scientific relevance.
The aim of mobility is to carry out training activities abroad to replace a part of your study plan, including the internship. Thus, all the activities that can be carried out abroad should be related to the topics and areas of study covered by the curricula on which the Degree Course is structured.
The planning of the study program (Learning Agreement, LA) must be prepared in collaboration with the Erasmus Coordinator, both for the choice of exams and the organization of traineeships. The program must include activities for a number of ECTS proportional to the length of the stay, in accordance with the general rules of the University of Milan.

To carry out any experimental activity that will be the whole internship, or part of it, both an acceptance letter from the hosting lab and from an internal teacher who will act as tutor and / or supervisor (Relatore) are required. These letters must be sent to the ERASMUS Manager at the time of writing the LA.

All activities will be validated in the student's career, as long as they are completed with positive results (achievement of at least 70% of the credits planned by the LA) and certified by the host university at the end of the student's stay. The Interdepartmental Teaching Board will decide on the recognition of the credits and marks of the exams taken on the basis of a predefined conversion scale.
In addition, the participation to the Erasmus + programs will be taken into account in the final definition of the graduation mark, in accordance to the extension and quality of the period spent abroad.

**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

| | | | |
|---|---|---|---|
| ***1st COURSE YEAR Core/compulsory courses/activities common to all curricula*** | | | |
| **Learning activity** | | **Ects** | **Sector** |
| English assessment B1 (1 ECTS) | | 1 | ND |
| General and inorganic chemistry | | 8 | CHIM/03 |
| General e Cellular Biology | | 10 | BIO/13 |
| Informatics and Statistics for Biotechnologies (common) | | 6 | MAT/09, FIS/08, MAT/01, FIS/07, MAT/02, FIS/06, MAT/03, FIS/05, MAT/04, MAT/05, FIS/04, MAT/06, FIS/03, FIS/02, MAT/07, FIS/01, MAT/08, SECS-S/02, SECS-S/01, INF/01 |
| Mathematics for Biotechnology | | 6 | MAT/09, MAT/01, MAT/02, MAT/03, MAT/04, MAT/05, MAT/06, MAT/07, MAT/08 |
| Organic chemistry | | 8 | CHIM/06 |
| Physics | | 6 | FIS/08, FIS/07, FIS/06, FIS/05, FIS/04, FIS/03, FIS/02, FIS/01 |
| | Total compulsory credits | 45 | |
| ***Elective courses common to all curricula*** | | | |
| **The student must choose one of the following courses** | | | |
| | | 8 | AGR/07, BIO/18 |
| Genetics | | 8 | AGR/07, BIO/18 |
| | | | |
| ***2nd COURSE YEAR Core/compulsory courses/activities common to all curricula*** | | | |
| **Learning activity** | | **Ects** | **Sector** |
| Biochemistry | | 9 | BIO/10 |
| Fundamentals of economy and Bioethics | | 6 | MED/02, SECS-P/06, IUS/01, AGR/01, IUS/04 |
| General Microbiology | | 9 | BIO/19 |
| Molecular Biology | | 9 | BIO/11 |
| | Total compulsory credits | 33 | |
| ***Further elective courses common to all curricula*** | | | |
| **Students will have to achieve 12 free-choice CFU.** | | | |
| | | | |

| End of course requirements common to all curricula | | | |
|---|---|---|---|
| FINAL EXAM | | 5 | ND |
| Lab training | | 8 | ND |
| | Total compulsory credits | 13 | |

## ACTIVE CURRICULA LIST

Agrifood biotechnology Course years currently available: 1°, 2°, 3°
Comparative animal biotechnology Course years currently available: 1°, 2°, 3°
Pharmaceutical biotechnology Course years currently available: 1°, 2°, 3°
Molecular biotechnology and bioinformatics Course years currently available: 1°, 2°, 3°

**Procedure for choosing a curriculum**

The course is divided into a common period, lasting three semesters, in which students acquire the basic molecular, cellular and methodological skills essential for further study. In the following three semesters, the student will be able to choose one of the following curricula to deepen some of their own and professionalising aspects of biotechnology:
- Agri-food curriculum
- Comparative animal biotechnology curriculum
- Pharmaceutical curriculum
- Molecular-bioinformatics curriculum

The choice of curriculum will be formalized with the presentation of the study plan at the end of the first semester of the second year. After that, the student will have the possibility to change the curriculum upon presentation of a motivated request to the Interdepartmental Didactic Board.
Each curriculum has the objective of offering students the opportunity to acquire skills and improve in the areas of Biotechnology that best meet their interests, as specified in the following paragraphs.

### *CURRICULUM: [K06-E] Agrifood biotechnology*

**Qualifying Training Objectives**

The aim of the curriculum is to prepare experts who have basic knowledge in plant and microbial systems interpreted in a molecular and cellular key.

**Skills acquired**

Graduates will have a detailed knowledge of physiology, biochemistry, genetics and molecular biology, related to development and reproduction of food and non-food crops.
The training will also include skills related to crop genetic improvement; sustainability in agricultural practices; phytopathology; transformation processes to obtain non-food plant products. Particular attention will be paid to the use of molecular techniques in plant and food production, with an emphasis on crop propagation, cultivation, protection, and genetic improvement.

**Professional profile and employment possibilities**

The agri-food curriculum provides the type of credits necessary to access the profession of agricultural biotechnologist. The agricultural plant biotechnologist will be able to find employment in the following:
- public and private research institutions (MIUR, MIPAF, Agency for New Technologies, Energy and Environment etc.) committed to the development of innovative crops having specific characteristics and reduced environmental impact;
- ARPA and private laboratories that perform GMOs detection in agro-food chains and in the environment;
- plant variety certification centers;
- industrial sectors for the reproduction of food and non-food plants (nursery gardening);
- industrial production of biofertilizers and plant inoculant symbiotic bacteria
- industrial production of high-value plant-based molecules (proteins, vitamins, drugs) and pesticides;
- public and private agencies for phytosanitary control and plant protection;
- public and private centers for environmental remediation and conservation;
- international cooperation

| 2nd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Agrifood biotechnology | | | |
|---|---|---|---|
| **Learning activity** | | **Ects** | **Sector** |
| Applied molecular biotechnologies | | 11 | BIO/10 |
| Botany and cropping systems | | 9 | AGR/02, BIO/01, AGR/04 |
| Chemistry and Biochemistry of Agri-Food Molecules | | 8 | BIO/10, CHIM/06 |
| Plant physiology and biochemistry | | 7 | AGR/13 |
| | Total compulsory credits | 35 | |

| 3rd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Agrifood biotechnology | | | |
|---|---|---|---|
| **Learning activity** | | **Ects** | **Sector** |
| | | | |

| | | | |
|---|---|---|---|
| Biotechnology for plant protection | | 10 | AGR/11, AGR/12 |
| Careers in biotechnology | | 2 | ND |
| In vitro plant breeding | | 5 | AGR/03 |
| Microbial agrobiotechnology | | 6 | AGR/16 |
| Plant genomics and breeding | | 11 | AGR/07 |
| | Total compulsory credits | 34 | |

***CURRICULUM: [K06-F] Comparative animal biotechnology***

**Qualifying Training Objectives**

The comparative animal biotechnology curriculum aims at training graduates with theoretical and practical skills in the main fields of biotechnology applied to cells, tissues and animal organisms.

**Skills acquired**

Learning of molecular and cell culture techniques, manipulation and cryopreservation of gametes and embryos of domestic animals and bioinformatics skills applied to the analysis of biological data, acquisition of knowledge of regulatory and bioethical aspects and related to the fields of interest of biotechnology. Students will also acquire techniques related to the development of animal models and in vitro models; principles and approaches of cell therapy and regeneration; cell biology methods such as 2D and 3D cultures and isolation and characterization of stem cells.

**Professional profile and employment possibilities**

The curriculum provides professional skills required to find employment:
- in public and private scientific research bodies;
- in public and private analytical laboratories;
- in public and private technological development laboratories;
- in pharmaceutical, food and feed industrial sectors;
- in international cooperation institutions.

***2nd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Comparative animal biotechnology***

| Learning activity | | Ects | Sector |
|---|---|---|---|
| Animal physiology and assisted reproduction | | 9 | VET/10, VET/02 |
| Comparative and laboratory animal pathology | | 7 | VET/03 |
| Development, morphology and function of organs and systems | | 8 | VET/01 |
| Veterinary microbiology and immunology | | 6 | VET/05 |
| | Total compulsory credits | 30 | |

***3rd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Comparative animal biotechnology***

| Learning activity | | Ects | Sector |
|---|---|---|---|
| Biotechnology applied to animal nutrition and animal origin food | | 12 | (6) AGR/18, (6) VET/04 |
| Infectious and parasitic diseases | | 10 | VET/06, VET/05 |
| Molecular genetics and animal models | | 8 | AGR/17, AGR/20 |
| Veterinary pharmacology and biotechnology law | | 9 | VET/07, VET/08 |
| | Total compulsory credits | 39 | |

***CURRICULUM: [K06-G] Pharmaceutical biotechnology***

**Qualifying Training Objectives**

The pharmaceutical curriculum is intended to train graduates to acquire specific knowledges in the methodologies useful to design, produce, test and develop biotechnological drugs, as well as in the information and clinical monitoring of biotechnological drugs.

**Skills acquired**

Graduates will be able to acquire operational and application skills that allow them to perform: biotechnological analysis and experimentation, production of biotechnological drugs, construction of vectors and engineered systems for the production of drugs, screening of drugs and biotechnological products, research on databases, technical coordination of research groups, development of biotechnological systems for toxicological studies related to drugs and environmental contamination.

**Professional profile and employment possibilities**

The pharmaceutical curriculum will prepare students for professional activities that involve the development and use of diagnostic tests, quality control in biotechnological industries, the use of biotechnological techniques in biomedical research as well as clinical monitoring of biotechnological drugs, specific skills in the patenting of biotechnological products. The pharmaceutical curriculum prepares for industrial marketing and provides the type of credits needed to access the profession of "medical-scientific informant "

***2nd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Pharmaceutical biotechnology***

| Learning activity | | Ects | Sector |
|---|---|---|---|
| ANALYTICAL METHODS FOR PHARMACEUTICAL BIOTECHNOLOGIES | | 7 | CHIM/01, CHIM/08 |
| Human physiology and basic anatomy | | 10 | BIO/09 |
| Methods in Cell Biology and Biochemistry | | 7 | (0) BIO/10, (0) BIO/13 |
| Pharmacology | | 8 | BIO/14 |
| | Total compulsory credits | 32 | |

### *3rd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Pharmaceutical biotechnology*

| Learning activity | | Ects | Sector |
|---|---|---|---|
| Generale Pathology, Immunology and Medical Microbiology | | 11 | MED/04, MED/07 |
| Medicinal Chemistry and Bioprocesses | | 10 | CHIM/11, CHIM/08 |
| Pharmaceutical Technology and Legislation of Biotechnological Medicinal Products | | 6 | CHIM/09 |
| Pharmacological and toxicological biotechnology | | 10 | BIO/14 |
| | Total compulsory credits | 37 | |

***CURRICULUM: [K06-H] Molecular biotechnology and bioinformatics***

**Qualifying Training Objectives**

The molecular-bioinformatics curriculum aims at providing detailed knowledge on the biotechnological use of eukaryotic and prokaryotic organisms, cells and biological macromolecules (proteins, both natural and engineered nucleic acids) for the development and improvement of processes and products for the chemical, pharmaceutical, diagnostic, food, personal care fields.

**Skills acquired**

The student will acquire all the basic tools and knowledge needed in biotechnological research groups, biomedical research support services as well as the field of technical-scientific dissemination and marketing.

**Professional profile and employment possibilities**

Specific employment opportunities for the molecular-bioinformatics curriculum include junior level positions in research laboratories or biotechnology companies, in particular in big data management for biological and biotechnological data. Students will attend orientation activities, such as meetings and seminars of experts in the various sectors of industrial biotechnology.

### *2nd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Molecular biotechnology and bioinformatics*

| Learning activity | | Ects | Sector |
|---|---|---|---|
| Animal cell biotechnology | | 6 | BIO/17, BIO/13 |
| Chemical methods for biotechnology | | 8 | CHIM/02, CHIM/06 |
| Fermentation Biotechnology | | 6 | BIO/11, CHIM/11, BIO/18 |
| Plant Biology and Physiology | | 8 | BIO/18, BIO/01, BIO/04 |
| | Total compulsory credits | 28 | |

### *3rd COURSE YEAR Core/compulsory courses/activities Curriculum-specific features Molecular biotechnology and bioinformatics*

| Learning activity | | Ects | Sector |
|---|---|---|---|
| Biochemistry and molecular biology: applications in biotechnology | | 12 | BIO/11, BIO/10 |
| Bioinformatics and Computational biology | | 12 | (6) BIO/11, (6) BIO/10, (12) INF/01 |
| Careers in biotechnology | | 2 | ND |
| Microbial biotechnology | | 6 | BIO/19, BIO/18 |
| Plant industrial biotechnology | | 9 | AGR/07, BIO/18 |
| | Total compulsory credits | 41 | |

## *COURSE PROGRESSION REQUIREMENTS*

The students have to successfully complete the propaedeutic exams listed in column 1, before those listed in column 2 of the following table.

In the event that the list of propaedeutic exams changes, the students will have to comply with the list approved in the previous Academic Year

| Learning activity | Prescribed foundation courses | O/S |
|---|---|---|
| Biochemistry | General and inorganic chemistry | Recommended |
| | General e Cellular Biology | Recommended |
| | Physics | Recommended |
| | Organic chemistry | Recommended |
| | Genetics | Recommended |
| Molecular Biology | Biochemistry | Recommended |
| | Genetics | Recommended |
| Plant Biology and Physiology | General and inorganic chemistry | Core/compulsory |

| | | |
|---|---|---|
| | General e Cellular Biology | Core/compulsory |
| | Organic chemistry | Recommended |
| | Genetics | Recommended |
| Fermentation Biotechnology | Biochemistry | Recommended |
| | General Microbiology | Recommended |
| Biochemistry and molecular biology: applications in biotechnology | Biochemistry | Recommended |
| | Molecular Biology | Recommended |
| | General and inorganic chemistry | Recommended |
| | Genetics | Recommended |
| Plant industrial biotechnology | Genetics | Recommended |
| Microbial biotechnology | General Microbiology | Recommended |
| Molecular genetics and animal models | Genetics | Core/compulsory |
| Pharmaceutical Technology and Legislation of Biotechnological Medicinal Products | Pharmacology | Core/compulsory |
| | General and inorganic chemistry | Core/compulsory |
| | Organic chemistry | Core/compulsory |
| ANALYTICAL METHODS FOR PHARMACEUTICAL BIOTECHNOLOGIES | Biochemistry | Core/compulsory |
| | General and inorganic chemistry | Core/compulsory |
| | Physics | Core/compulsory |
| | Organic chemistry | Core/compulsory |
| Pharmacological and toxicological biotechnology | Biochemistry | Core/compulsory |
| | Pharmacology | Core/compulsory |
| | Human physiology and basic anatomy | Core/compulsory |
| Pharmacology | General e Cellular Biology | Core/compulsory |
| Medicinal Chemistry and Bioprocesses | Biochemistry | Core/compulsory |
| | General and inorganic chemistry | Core/compulsory |
| | Organic chemistry | Core/compulsory |
| Human physiology and basic anatomy | General e Cellular Biology | Core/compulsory |
| | Physics | Recommended |
| Microbial agrobiotechnology | Biochemistry | Recommended |
| | Molecular Biology | Recommended |
| | General Microbiology | Core/compulsory |
| Applied molecular biotechnologies | Biochemistry | Recommended |
| Informatics and Statistics for Biotechnologies (common) | Mathematics for Biotechnology | Core/compulsory |
| Methods in Cell Biology and Biochemistry | Biochemistry | Recommended |
| | Molecular Biology | Recommended |
| | General e Cellular Biology | Recommended |
| Organic chemistry | General and inorganic chemistry | Core/compulsory |
| Generale Pathology, Immunology and Medical Microbiology | Biochemistry | Core/compulsory |
| | Human physiology and basic anatomy | Core/compulsory |
| | General Microbiology | Core/compulsory |