UNIVERSITA' DEGLI STUDI DI MILANO
PROGRAMME DESCRIPTION - ACADEMIC YEAR 2026/27
MASTER DEGREE
CHEMISTRY (Classe LM-54 R)
Enrolled in the academic year 2025-2026

HEADING

Degree classification - Denomination and code:	LM-54 R
Degree title:	Dottore Magistrale
Curricula currently available:	
Length of course:	2 years
Credits required for admission:	180
Total number of credits required to complete programme:	120
Years of course currently available:	2nd
Access procedures:	Open, subject to entry requirements
Course code:	FBC

PERSONS/ROLES

Head of Study Programme

prof.ssa Francesca Tessore

Tutors - Faculty

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Tutor per la mobilità internazionale e l'Erasmus
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Degree Course website

https://scienzechimiche.cdl.unimi.it

Office for Didactic, Department of Chemistry

Email: didattica.dipchi@unimi.it

Referring Department Department of Chemistry

Via Golgi, 19 - 20133 MILANO http://www.chimica.unimi.it

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CHARACTERISTICS OF DEGREE PROGRAMME

General and specific learning objectives

The primary objective of the Master?s Degree program in Chemical Sciences is to train specialized graduates in chemical sciences who can competently apply chemical procedures and protocols, develop and characterize new products and materials, experiment with new technologies, conduct chemical analyses, and perform quality controls requiring full mastery of chemical and instrumental techniques. Additionally, graduates will be capable of processing acquired data, preparing reports on analysis results, and conducting laboratory tests to develop new products.

Within this framework, the Master?s Degree program aligns with European standards for the teaching of Chemical Sciences, aiming to provide specific competencies, particularly in chemical disciplines and their applications. Graduates will be able to provide expert opinions in pure and applied chemistry and perform all activities defined by current legislation related to the profession of chemist.

Another specific objective of the program is to enable students to immediately enter professional practice or pursue further advanced studies (Ph.D. or Master's programs). Consequently, the program aims to provide students with comprehensive mastery of scientific methods and content in the chemical field, facilitating a smooth transition into the workforce or further academic pursuits.

In detail, graduates of this program will have:

Specialized and in-depth knowledge of various branches of chemistry, including theoretical and experimental aspects;
Complete mastery of the scientific method of inquiry;
Full autonomy in the workplace, enabling them to hold high-responsibility roles in project development and organizational structures;
Expertise in techniques for understanding phenomena at the molecular level and specialized skills in specific areas of chemistry and biochemistry;
The ability to apply innovative methods and techniques and operate complex equipment;
Advanced knowledge of modern synthesis methodologies for chemical compounds, such as pharmaceuticals, bio-organic and bio-inorganic molecules, new materials, homogeneous and heterogeneous catalysts;
Proficiency in the spectroscopic and structural characterization of chemical compounds, including materials used in cultural heritage;
A solid foundation for applying theoretical methods of simulation and computational modeling to chemical systems;
A strong understanding of mathematical and computational tools for support;
The ability to use at least one European Union language fluently, in both written and spoken forms, in addition to Italian;
The adaptability to keep pace with the continuous evolution of chemical disciplines and interact with closely related professional fields.

Graduates may register (after passing the relevant state examination) with the National Order of Chemists and Physicists as CHEMISTS (Section B ? Chemistry), to perform activities recognized under current regulations.

EuroMaster® Certification
The Master?s Degree in Chemical Sciences at the University of Milan was one of the first in Italy to receive the EuroMaster Label in September 2010. This accreditation is awarded by a dedicated commission appointed by the European Thematic Network Association (https://ectn.eu/), which brings together European universities and chemical societies.

Expected learning outcomes

The graduate with a Master?s degree in Chemical Sciences possesses the knowledge and comprehension skills necessary to perform highly qualified professional activities in corporate management and research laboratories within the chemical and pharmaceutical-chemical fields. In addition to an in-depth understanding of chemical science and technology and managerial tasks, they also demonstrate the rigor required to apply knowledge and understanding through precise use of the scientific method.

They are capable of organizing research activities, defining development themes and related programs, ensuring the integrated coordination of various research sectors, maintaining scientific updates, verifying results, and promoting their development and application. Furthermore, they have the ability to adapt to the continuous evolution of chemical disciplines and interact with related professional fields.

Regarding independent judgment, the graduate in Chemical Sciences is skilled in interpreting experimental data and possesses the tools to frame specific chemical knowledge within its relationships to other scientific and technical disciplines. They can design and carry out experiments, plan schedules and methodologies, and independently evaluate the final outcomes. They are also proficient in managing projects, structures, and personnel, identifying new perspectives and innovative development strategies, and evaluating, interpreting, and re-elaborating literature data with professional integrity.

In terms of communication skills, the graduate in Chemical Sciences is able to thoroughly communicate the results of their research and assessments to audiences, including those not specialized in chemical sciences. Additionally, they are capable of coordinating group activities and interacting with international colleagues using the English language.

Regarding learning abilities, the graduate possesses the capacity to continually update their scientific and professional education through critical consultation of bibliographic sources and databases. They are adept at working towards objectives independently and in teams, positively addressing encountered problems, and are inclined to develop and continuously enhance their knowledge. This includes expertise in chemical fields (specialized texts, scientific journals, and multimedia educational tools, even in foreign languages) as well as in related and complementary areas (including legal and/or economic aspects) essential for managing complex projects.

Professional profile and employment opportunities

CHEMIST

Role in a work context:

This graduate conducts research, experiments, and qualitative and quantitative analyses on natural or synthetic substances and their mixtures, identifies their composition and chemical and energetic variations, determines and applies investigation methods, and formulates theories and laws based on observations. They improve the synthesis of known substances and synthesize new ones. Additionally, they investigate the chemical properties of known materials, planning and producing new ones.

The graduate with a Master's Degree in Chemical Sciences can practice as a chemist autonomously or as a freelancer by registering in "Section A" of the Professional Register of the Order of Chemists and Physicists. They can carry out activities promoting and developing scientific and technological innovation, as well as managing and designing technologies, and undertake roles of high responsibility in industries, environmental sectors, healthcare, cultural heritage, and public administration.

Skills associated with the role:

The graduate in Chemical Sciences possesses in-depth knowledge in chemical sciences, including the synthesis and characterization of new products and materials, health, nutrition, cosmetics, energy, sustainable development, and green chemistry for environmental protection and the energy transition. They can manage the synthesis and characterization of complex compounds using innovative procedures and advanced instrumentation. They can assess the best methodologies to solve analytical problems and determine complex molecular structures by applying chromatographic techniques, thermal analysis, electrochemistry, electrophoresis, and advanced spectroscopic methods (NMR, MS, etc.). They can interpret and rationalize scientific data comprehensively.

Career opportunities:

Graduates with a Master's Degree in Chemical Sciences can find employment in research institutions, public administrations, national or international consulting firms and professional practices, companies, industries, research laboratories, and quality control and certification laboratories requiring high qualifications in chemistry or related sciences. Additionally, they can pursue further studies in PhD programs or specialized scientific schools.

QUALITY ASSURANCE MANAGER

Role in a work context:

The Quality Assurance Manager is a crucial professional figure in the chemical and pharmaceutical industries, as good manufacturing practices and laboratory practices require holders of production authorizations for chemical products and processes, including medicines, to maintain a quality assurance system. This role coordinates the services and departments involved in manufacturing to ensure an efficient, controlled, and documented quality control system. They must ensure periodic and proper inspections to evaluate the system's effectiveness and applicability.

Skills associated with the role:

This professional collaborates with and coordinates the infrastructures and services involved in production. Necessary skills for this role include analytical and synthesis capabilities, resource management and coordination, teamwork skills, and the ability to navigate various business areas.

Career opportunities:

This role is found in companies, chemical and pharmaceutical industries, analysis laboratories, and environments requiring high qualifications in quality management.

CHEMICAL AND PHARMACEUTICAL LABORATORY MANAGER/DIRECTOR

Role in a work context:

This professional defines development themes and research programs aligned with business strategies. They provide integrated support across research and production sectors, allocate technical resources to projects, propose research investments, and formulate budgets. They design and synthesize new products and manage certifications, storage, and transportation. Key responsibilities include research planning, conducting necessary tests and experiments, selecting methods, tools, and timelines, and addressing issues related to project implementation.

Skills associated with the role:

This graduate has advanced professional, technical-scientific, and specialized skills in the chemical and pharmaceutical fields. They can execute research projects within predefined times and costs, interpret and evaluate experimental results, and have planning and management capabilities. They also demonstrate financial resource management and team leadership

skills.

Career opportunities:
This role is available in research institutions, industries, research laboratories, analysis facilities, and work environments requiring high qualifications in chemistry or related sciences.

SCIENTIFIC INFORMANT AND COMMUNICATOR
Role in a work context:
This graduate enhances scientific knowledge, applying and transferring it to industries, medicine, pharmacology, and other production sectors. They inform industrial operators about the characteristics and properties of their company's products, propose adopting specific products, and develop scientific information activities within interested companies to ensure proper use. The role of a Scientific Informant is regulated by State laws.

Skills associated with the role:
Required skills include scientific knowledge and commercial abilities. Specifically, they must have: strong foundational knowledge in chemistry, familiarity with pharmaceutical, cosmetic, and food products and their proper use. Additional skills include proficiency in technical English, computer literacy, communication skills, and proactivity.

Career opportunities:
Scientific informants work in cosmetic, pharmaceutical, food, plastic, dye, detergent, adhesive, or environmental companies, or generally in chemical industries or for specialized publications.

Compulsory attendance

Attendance at laboratory activities is mandatory; in all other cases it is strongly recommended.

Internship criteria

Characteristics of the Internship and Thesis Laboratory
During the second year of the program, students will undertake an experimental internship (15 ECTS), followed by a thesis laboratory (24 ECTS), both of which are preparatory to the drafting of the master’s thesis. The thesis consists of a written dissertation on original chemical research conducted by the student under the guidance of a Supervisor and, potentially, a Co-Supervisor, within the research laboratory specified in the admission application. The experimental internship and thesis laboratory have a minimum duration of one calendar year, including attendance of the courses scheduled for the same year.

Theses are categorized as:

Internal Experimental Theses
External Experimental Theses

Internal Experimental Theses are those conducted within the Department of Chemistry or departments affiliated with the Faculty of Science and Technology at the University of Milan. Within these theses, students may undertake internships at public or private organizations or companies, under the guidance of an external supervisor, with the approval of their Thesis Supervisor. The internship can last for a maximum of 20 ECTS, even if split into non-continuous periods. Such internships must be approved by the Teaching Board of the Department of Chemistry.

External Experimental Theses are conducted at other university facilities, either within the University of Milan or at another institution, or at public or private non-profit research centers with suitable infrastructures. Approval for conducting these theses is granted by the Teaching Board of the Department of Chemistry.

In this case, the student must submit an application for admission to the external thesis laboratory, attaching:

A written motivation for the external experimental thesis (one typed page) signed by the student and countersigned by the supervisor (the supervisor must meet the requirements outlined later);
A detailed research plan (one typed page);
A declaration from the host institution confirming their willingness to host the student free of charge and to provide access to their scientific equipment without cost.

Applications must be submitted well in advance to allow for approval by the Teaching Board in the month preceding the start of the thesis. Students are advised to consult the relevant regulations, available on the program website, and contact the Thesis and Internship Committee for guidance.

Students conducting internships at external entities or pursuing external experimental theses are required to report biweekly to their Supervisor and another faculty member appointed by the Thesis and Internship Committee in consultation with the Supervisor, detailing the activities and experiences conducted outside the department.

Detailed information on the Experimental stage and the Thesis work, as well as the requirements and how to apply, can be found on the degree course website at https://scienzechimiche.cdl.unimi.it/it/studiare/stage-e-tirocini.

Degree programme final exams

To graduate, students must earn 120 ECTS. To qualify for the final examination, students must have passed all courses in their study plan. The final examination consists of a public presentation and discussion of the master's thesis, which may be theoretical and/or experimental and must provide an original contribution to chemical science. The thesis may be written in Italian or English. In either case, an English summary (maximum five typed pages) must be prepared and submitted according to the deadlines indicated on the website:
https://scienzechimiche.cdl.unimi.it/it/studiare/laurearsi.

Graduation Examination Sessions

- July 2027
- October 2027
- December 2027
- February 2028
- April 2028

Notes

"In order to obtain their degree, students are required to have a B2 level of proficiency according to the Common European Framework of Reference for Languages (CEFR). This level of proficiency can be certified as follows:
- by submitting an official language certificate at B2 level or higher, issued no more than three years before the submission date. The list of language certificates recognized by the University is available at https://www.unimi.it/en/node/39322.
The certificate must be uploaded during enrolment or later through the portal http://studente.unimi.it/uploadCertificazioniLingue.
- By taking a placement test administered by the University Language Centre (SLAM) between October and January (December for Bachelor?s degree courses) of the first year. Students who do not pass the test will be required to attend a language course offered by SLAM.

The placement test is compulsory for all students who do not already hold a valid certificate.
Students who do not take the placement test by the end of January (end of December for Bachelor?s degree courses) or fail the end-of-course exam after six attempts must obtain a language certificate 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 organisations.

Similar international mobility opportunities are provided outside Europe, through agreements with a number of prestigious institutions.

The University of Milan is a member of the 4EU+ European University Alliance that brings together eight public multidisciplinary universities: University of Milan, Charles University of Prague, Heidelberg University, Paris-Panthéon-Assas University, Sorbonne University of Paris, University of Copenhagen, University of Geneva, and University of Warsaw. The 4EU+ Alliance offers integrated educational pathways and programmes to promote the international mobility of students (physical, blended and virtual).

Study and internships abroad

As part of the study plan, students can participate in the Erasmus program projects activated for the Degree Course. In particular, within the Erasmus + programme, students can choose between 16 associated European universities. At these locations, students can obtain training credits by following courses and passing the relevant exams, or by carrying out part or all of the experimental internship and the final thesis laboratory. The acquisition of training credits is subject to approval by the Teaching Committee of a specific study plan (Learning Agreement) and the passing of exams at the foreign institution.
Interested students are asked to make an appointment in advance with the Tutor for international mobility and Erasmus (prof. Emma Gallo, Tel. 0250314374; e-mail: emma.gallo@unimi.it) for the preparation of the procedures. Students can also participate in numerous seminar meetings with foreign Teachers.

How to participate in Erasmus mobility programs

How to participate in Erasmus+ mobility programmes

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 organises 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;
Student Desk booking through InformaStudenti

1st COURSE YEAR (disactivated from academic year 2026/27) Core/compulsory courses/activities common to all curricula			
Learning activity		**Ects**	**Sector**
English proficiency B2 (3 ECTS)		3	NN
	Total compulsory credits	3	
End of course requirements common to all curricula			
Experimental stage		15	NN
Thesis work and Final dissertation		24	NN
	Total compulsory credits	39	

ACTIVE CURRICULA LIST

ANALYTICAL AND PHYSICAL CHEMISTRY SCIENCES AND TECHNOLOGIES Course years currently available: 2nd
MOLECULES AND MATERIALS : DESIGN, SYNTHESIS AND APPLICATIONS Course years currently available: 2nd

Procedure for choosing a curriculum

The Master’s Degree in Chemical Sciences offers two curricula designed to meet the demand for specialization and the desire of individual students to focus on specific disciplinary fields. At the same time, it maintains the overall coherence of the educational path, ensuring that graduates possess the skills needed to address any issue in the field of chemical sciences.
Two DOUBLE DEGREE programs with French universities are also available.
Students are required to select their preferred curriculum or Double Degree track from the options offered.
DOUBLE DEGREE PROGRAM DD1

Master’s Degree in Chemical Sciences and Master’s in Bio-Informatics, Track: In Silico Drug Design-Bioactive Molecules

The University of Milan, in collaboration with Université Paris Cité, offers an international educational pathway that leads to a Double Degree (DD): a Master’s Degree in Chemical Sciences (awarded by the University of Milan) and a Master’s Degree in Bio-Informatics, Track: In Silico Drug Design-Bioactive Molecules (awarded by Université Paris Cité).
This program aims to provide advanced training in physical chemistry, molecular modeling, and methodologies for the design and development of new drugs.

The program is semester-based and includes a well-defined set of educational activities designed to meet the learning

objectives of both degree programs. Educational activities will take place in the second semester at the University of Milan and in the first and third semesters at Université Paris Cité. The fourth semester, dedicated entirely to the thesis project, can be completed at the University of Milan, Université Paris Cité, or another university with a student mobility agreement.

The thesis must comply with the regulations of each institution, and for students completing their thesis abroad, an internal advisor must be appointed. The final thesis must be written in English.

Course Distribution for the 1st and 2nd Years:

FIRST YEAR, 1st SEMESTER (PARIS)
-> Students will attend the following courses at Université Paris Cité: Methodology (9 ECTS, 6 ECTS INF/01, 3 ECTS CHIM/02); Chemistry (12 ECTS, CHIM/06); Molecular Modeling and Chemoinformatics (9 ECTS, CHIM/02).

FIRST YEAR, 2nd SEMESTER (MILAN)
Students will attend the following courses at the University of Milan: Chemometrics (6 ECTS, CHIM/01); Protein Engineering and Molecular Enzymology (6 ECTS, BIO/10); Medicinal Chemistry (6 ECTS, CHIM/08); Simulation Modeling of Biomolecules (6 ECTS, CHIM/02); C Language Programming or Synthetic Methods in Biotechnology or any course available in Milan during the semester (6 ECTS).

SECOND YEAR, 1st SEMESTER (PARIS)
Students will attend the following courses at Université Paris Cité: Application in Drug Design (6 ECTS, part of the thesis laboratory), Structural and AI Analysis for Drug Design (9 ECTS, CHIM/02); Virtual Screening: Structure & Ligand-Based (6 ECTS, CHIM/06); Space Analysis of Molecules (6 ECTS, CHIM/04); Preparation for Research in Drug Design (3 ECTS, part of the thesis laboratory).

SECOND YEAR, 2nd SEMESTER: Thesis laboratory and final examination (30 ECTS).

DOUBLE DEGREE PROGRAM DD2

Master’s Degree in Chemical Sciences and Master’s in Chemistry, Specialty: Chemoinformatics

A maximum of 10 students may be admitted to this international track.

The University of Milan, in collaboration with the University of Strasbourg, offers an international educational pathway that leads to a Double Degree (DD): a Master’s Degree in Chemical Sciences (awarded by the University of Milan) and a Master’s Degree in Chemistry, Specialty: Chemoinformatics (awarded by the University of Strasbourg).
This program aims to provide advanced training in physical and computational chemistry, molecular modeling, and chemoinformatics.

The program is semester-based and includes a well-defined set of educational activities designed to meet the learning objectives of both degree programs. Educational activities will take place in the first and second semesters at the University of Milan and in the third semester at the University of Strasbourg. The fourth semester, dedicated entirely to the thesis project, can be completed at the University of Milan, the University of Strasbourg, or another university with a student mobility agreement.

The thesis must comply with the regulations of each institution, and for students completing their thesis abroad, an internal advisor must be appointed. The final thesis must be written in English.

Course Distribution for the 1st and 2nd Years:

FIRST YEAR (MILAN): Soft Matter: From Theory to Applications (9 ECTS, CHIM/02); Hard Matter: Fundamentals and Applications (9 ECTS, CHIM/02); C Language Programming (6 ECTS, INF/01) or any computer programming course available in Milan (6 ECTS); Mathematical Methods Applied to Chemistry (6 ECTS, MAT/01-09); Advanced Physical Methods in Organic Chemistry (6 ECTS, CHIM/06); Simulation Modeling of Biomolecules (6 ECTS, CHIM/02); Databases and Elements of Chemoinformatics (6 ECTS, CHIM/06). Additionally, students must choose an elective course worth 6 ECTS, acquire 3 ECTS for English language proficiency (B2 level), and 3 ECTS for the thesis project.

SECOND YEAR, 1st SEMESTER (STRASBOURG)
Students will attend the following courses at the University of Strasbourg: Chemoinformatics (9 ECTS, 6 ECTS CHIM/01, 3 ECTS CHIM/02); Modeling (9 ECTS, CHIM/02); Technology and Applications (12 ECTS, 6 ECTS CHIM/04, and 6 ECTS for the modules Drug Discovery (3 ECTS) and Internet Technology (3 ECTS) for the thesis project).

SECOND YEAR, 2nd SEMESTER: Thesis laboratory and final examination (30 ECTS).

Qualifying Training Objectives

CHEMICAL-ANALYTICAL AND CHEMICAL-PHYSICAL SCIENCES AND TECHNOLOGIES

This curriculum aims to provide knowledge of the theoretical principles underlying the fundamental phenomena of chemical processes, the structural and functional characteristics of molecules and materials, and the practical and instrumental aspects, including application examples, of the main techniques for qualitative and quantitative determination of sample composition and for investigating the properties of molecules and materials.

Skills acquired

The courses included in this curriculum will enable students to:

- Acquire knowledge and skills related to the main electroanalytical, spectroscopic, spectrometric, chromatographic, diffractometric, and thermal techniques.
- Understand the principles of soft matter, hard condensed matter, state-of-the-art experimental data simulation methods, photochemistry, advanced electrochemistry, heterogeneous catalysis, surface and interfacial chemistry, and quantum chemistry.
- Predict, investigate, and interpret the behavior of both simple and complex systems using existing or ad hoc-developed theoretical, computational, and experimental methods.
- Comprehend the molecular and statistical mechanical properties of highly complex systems and their evolution over time, with a view to exploiting and applying them in the context of sustainability and circularity of methods and processes.
- Provide tools and methods for the characterization of complex matrices (biological systems, natural substances, industrial products, etc.), the development of advanced devices, and the protection of the environment and cultural heritage.
- Learn best operational practices in analytical laboratories, fundamental methods for assessing data quality, and criteria for designing and selecting experimental methods, also within a Quality by Design framework.

Professional profile and employment possibilities

- Research organisations, public administrations, professional companies and national or international consultancy firms, companies, industries and research, analysis, quality control and certification laboratories as well as work environments requiring high qualifications in chemistry or related sciences.
- Companies, chemical and chemical-pharmaceutical industries and laboratories for analysis, quality control and certification as well as in working environments requiring high qualifications in quality management.
- Research organisations, industries and laboratories for research, analysis and work environments requiring high qualifications in chemistry or related sciences.
- Information and scientific dissemination for cosmetic, pharmaceutical, food, plastics, dyes, detergents, glues or environmental companies, or in general for all companies in the chemical sector and/or specialist journals.

In addition, it is possible to continue studies in Doctorate courses or Specialisation Schools in the scientific field.

Further elective courses Curriculum-specific features ANALYTICAL AND PHYSICAL CHEMISTRY SCIENCES AND TECHNOLOGIES

TABLE A1

The student must choose 2 courses from 9 CFU and 3 courses from 6 CFU, making sure to acquire at least 6 CFU for each of the two disciplinary areas (SSD) present, for a total of 36 CFU.

Analytical technologies for the diagnostics of cultural heritage *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01
Catalysis: Fundamentals and Applications for the Environment and the Circular Economy	6	CHIM/02
Chemical-physical transformations of solids *(Course activated in alternate years: not active in 2025-2026, active in 2026-2027)*	6	CHIM/02
Chemometrics	6	CHIM/01
Crystal chemistry	6	CHIM/02
Electroanalysis, Sensors and Quality by Design	9	CHIM/01
Electrochemistry	6	CHIM/02
Electronic properties of advanced materials *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/02
Environmental Chemistry	6	CHIM/01
Environmental impact assessment: management of contaminants and analysis tools	6	CHIM/01
Hard Matter: Fundamentals and Applications	9	CHIM/02
Instrumental Analytical Chemistry for the Environment and Materials	9	CHIM/01
Molecular modeling	6	CHIM/02
Molecular spectroscopy	6	CHIM/02
Photochemistry	6	CHIM/02
Photoluminescence and magnetic resonance: applications in inorganic and organometallic chemistry	6	CHIM/01
Quantum chemistry	6	CHIM/02
Simulation and modeling of biomolecules	6	CHIM/02
Soft Matter: From Theory to Applications	9	CHIM/02
Theoretical chemistry with elements of quantum computing	6	CHIM/02
Tools and techniques for the analysis of complex matrices *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01

TABLE A2

The student must choose 3 courses from 6 CFU, acquiring at least 6 CFU of each of the discipline areas (SSD) present, for a total of 18 CFU.

Advanced physical methods in organic chemistry	6	CHIM/06
Bioinorganic Chemistry: Enzyme Systems and Investigation Methods *Course activated in alternate years: inactive in 2025-2026, active in 2026-2027.*	6	CHIM/03
Bioorganic Chemistry	6	CHIM/06
Chemistry of natural products	6	CHIM/06
Databases and Elements of Chemoinformatics	6	CHIM/06
Fundamentals of chemical teaching	6	CHIM/03
History of Chemistry and Elements of Didactics	6	CHIM/03
Methods in Chemical Biology	6	CHIM/06
Physical-organic chemistry *(Activated starting from 2026/2027)*	6	CHIM/06
Plastics degradation and its environmental impact *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	CHIM/04
Polymer science	6	CHIM/04
Supramolecular chemistry	6	CHIM/03
Synthesis and applications of inorganic materials	6	CHIM/03

TABLE A3

The student must choose 2 Related and Integrative courses from 6 CFU, for a total of 12 CFU.

(Bio)nanotechnology	6	FIS/03
Applied Biocatalysis *Borrowed from MD in Biotechnology for the Bioeconomy*	6	CHIM/11
C language programming	6	INF/01
Chemical Safety *Course borrowed from LM Sustainable Industrial Chemistry*	6	IUS/07
Economics and management *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	SECS-P/08
Food Chemistry and Fermentations *(Borrowed from LM in Applied Biology in Nutrition Sciences)*	6	CHIM/11
Mathematical methods applied to chemistry	6	MAT/05
Medicinal chemistry	6	CHIM/08
Patents and management of innovation	6	SECS-P/07
Programming for Chemistry	6	INF/01
Protein biochemistry	6	BIO/10
Protein engineering and molecular enzymology *(Borrowed from MD in Molecular biology of the cell)*	6	BIO/10
Protein physics *(Borrowed from LM in Physics)*	6	FIS/03
Technological properties of minerals, cements and ceramics *(Course borrowed from MD in Earth Sciences)*	6	(3) GEO/06, (3) GEO/09
Toxicological Chemistry	6	(3) MED/44, (3) CHIM/08

TABLE A4

Students must indicate courses for a total of 12 credits, freely choosing from all courses offered by the University, provided they are relevant to their educational plan. The consistency of the chosen courses with the study plan will be evaluated by the Study Plan Committee.

The Teaching Board recommends selecting optional courses listed in Table A4 or, alternatively, Related and Supplementary courses from Table A3.

Advanced methods in organic synthesis	6	CHIM/06
Advanced physical methods in organic chemistry	6	CHIM/06
Analytical technologies for the diagnostics of cultural heritage *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01
Bioinorganic Chemistry: Enzyme Systems and Investigation Methods *Course activated in alternate years: inactive in 2025-2026, active in 2026-2027.*	6	CHIM/03
Bioorganic Chemistry	6	CHIM/06
Catalysis: Fundamentals and Applications for the Environment and the Circular Economy	6	CHIM/02
Catalytic Methodologies in Organic Synthesis	6	CHIM/06
Chemical-physical transformations of solids *(Course activated in alternate years: not active in 2025-2026, active in 2026-2027)*	6	CHIM/02
Chemistry of natural products	6	CHIM/06
Chemometrics	6	CHIM/01
Crystal chemistry	6	CHIM/02
Databases and Elements of Chemoinformatics	6	CHIM/06
Electrochemistry	6	CHIM/02
Electronic properties of advanced materials *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/02
Environmental Chemistry	6	CHIM/01
Environmental impact assessment: management of contaminants and analysis tools	6	CHIM/01
Fundamentals of chemical teaching	6	CHIM/03
History of Chemistry and Elements of Didactics	6	CHIM/03
Homogeneous Catalysis: Industrial Applications	6	CHIM/03
Metallorganic Chemistry	6	CHIM/03
Methods in Chemical Biology	6	CHIM/06
Molecular spectroscopy	6	CHIM/02
Nanoparticles: chemistry and applications	6	(3) CHIM/03, (3) CHIM/06
Photochemistry	6	CHIM/02
Photoluminescence and magnetic resonance: applications in inorganic and organometallic chemistry	6	CHIM/01
Physical-organic chemistry *(Activated starting from 2026/2027)*	6	CHIM/06
Plastics degradation and its environmental impact *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	CHIM/04
Polymer science	6	CHIM/04
Quantum chemistry	6	CHIM/02
Simulation and modeling of biomolecules	6	CHIM/02

Solid state Chemistry *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/03
Supramolecular chemistry	6	CHIM/03
Synthesis and applications of inorganic materials	6	CHIM/03
Technological properties of minerals, cements and ceramics *(Course borrowed from MD in Earth Sciences)*	6	(3) GEO/06, (3) GEO/09
Technology-driven organic synthesis	6	CHIM/06
Theoretical chemistry with elements of quantum computing	6	CHIM/02
Tools and techniques for the analysis of complex matrices *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01

CURRICULUM: [FBC-B] MOLECULES AND MATERIALS : DESIGN, SYNTHESIS AND APPLICATIONS

Qualifying Training Objectives

CURRICULUM B: MOLECULES AND MATERIALS: DESIGN, SYNTHESIS AND APPLICATIONS

This curriculum intends to provide solid and in-depth knowledge in the field of inorganic and organic chemistry advanced in their theoretical and experimental aspects to acquire the ability to design and perform efficient and sustainable syntheses for different applications, including those of high value-added molecules characteristic of related sectors in general to life sciences and new technologies.

Skills acquired

The courses available in this curriculum will allow the student to::

- deepen, at an advanced level, the knowledge of inorganic, organic and bioorganic reactions, their mechanisms and stereochemical implications;
- deepen the techniques based on the qualitative theory of molecular orbitals, useful in the study of the electronic structure, molecular geometry and reactivity of the complexes, to be able to qualitatively describe also at a theoretical level the electronic structure of the transition metal complexes and employ this information to rationalize or predict their geometry and reactivity;
- develop the ability to plan the synthesis of complex molecules, also using innovative digital tools, such as those dedicated to retrosynthetic analysis;
- develop the ability to design, also with computational methods, molecular structures with predefined properties depending on their use, for example in the medical, pharmacological and biotechnological fields or in that of new materials.

Professional profile and employment possibilities

- Research organisations, public administrations, professional companies and national or international consultancy firms, companies, industries and research, analysis, quality control and certification laboratories as well as work environments requiring high qualifications in chemistry or related sciences.
- Companies, chemical and chemical-pharmaceutical industries and laboratories for analysis, quality control and certification as well as in working environments requiring high qualifications in quality management.
- Research organisations, industries and laboratories for research, analysis and work environments requiring high qualifications in chemistry or related sciences.
- Information and scientific dissemination for cosmetic, pharmaceutical, food, plastics, dyes, detergents, glues or environmental companies, or in general for all companies in the chemical sector and/or specialist journals.

In addition, it is possible to continue studies in Doctorate courses or Specialisation Schools in the scientific field.

Further elective courses Curriculum-specific features MOLECULES AND MATERIALS : DESIGN, SYNTHESIS AND APPLICATIONS

TABLE B1

The student must choose 2 courses from 9 CFU and 3 lessons from 6 CFU, acquiring at least 6 CFU for each of the two disciplinary areas (SSD) present, for a total of 36 CFU.

Advanced methods in organic synthesis	6	CHIM/06
Advanced physical methods in organic chemistry	6	CHIM/06
Bioinorganic Chemistry: Enzyme Systems and Investigation Methods *(Course activated in alternate years: inactive in 2025-2026, active in 2026-2027)*	6	CHIM/03
Bioorganic Chemistry	6	CHIM/06
Catalytic Methodologies in Organic Synthesis	6	CHIM/06
Chemistry of natural products	6	CHIM/06
Databases and Elements of Chemoinformatics	6	CHIM/06
Fundamentals of chemical teaching	6	CHIM/03
History of Chemistry and Elements of Didactics	6	CHIM/03
Homogeneous Catalysis: Industrial Applications	6	CHIM/03
Metallorganic Chemistry	6	CHIM/03
Methods in Chemical Biology	6	CHIM/06
Molecular Orbitals of Transition Metal Complexes	9	CHIM/03
Organic Chemistry A	9	CHIM/06
Organic Chemistry B	9	CHIM/06
Physical-organic chemistry *(Activated starting from 2026/2027)*	6	CHIM/06
Solid state Chemistry *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/03
Supramolecular chemistry	6	CHIM/03
Synthesis and applications of inorganic materials	6	CHIM/03

Synthesis and Applications of Transition Metal Complexes	9	CHIM/03
Technology-driven organic synthesis	6	CHIM/06

TABLE B2

The student must choose 3 courses from 6 CFU, acquiring at least 6 CFU of each of the discipline areas (SSD) present, for a total of 18 CFU.

Catalysis: Fundamentals and Applications for the Environment and the Circular Economy	6	CHIM/02
Chemical-physical transformations of solids *(Course activated in alternate years: not active in 2025-2026, active in 2026-2027)*	6	CHIM/02
Chemometrics	6	CHIM/01
Crystal chemistry	6	CHIM/02
Electrochemistry	6	CHIM/02
Environmental Chemistry	6	CHIM/01
Photochemistry	6	CHIM/02
Photoluminescence and magnetic resonance: applications in inorganic and organometallic chemistry	6	CHIM/01
Plastics degradation and its environmental impact *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	CHIM/04
Polymer science	6	CHIM/04
Simulation and modeling of biomolecules	6	CHIM/02
Tools and techniques for the analysis of complex matrices *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01

TABLE B3

The student must choose 2 Related and Integrative courses from 6 CFU, for a total of 12 CFU.

(Bio)nanotechnology	6	FIS/03
Applied Biocatalysis	6	CHIM/11
C language programming	6	INF/01
Chemical Safety *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	IUS/07
Economics and management *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	SECS-P/08
Food Chemistry and Fermentations *(Course borrowed from LM in Applied Biology in Nutrition Sciences)*	6	CHIM/11
Mathematical methods applied to chemistry	6	MAT/05
Medicinal chemistry	6	CHIM/08
Patents and management of innovation	6	SECS-P/07
Programming for Chemistry	6	INF/01
Protein biochemistry *(Course borrowed from LM in Molecular Biology of the Cell*	6	BIO/10
Protein engineering and molecular enzymology	6	BIO/10
Protein physics	6	FIS/03
Technological properties of minerals, cements and ceramics *(Course borrowed from MD in Earth Sciences)*	6	(3) GEO/06, (3) GEO/09
Toxicological Chemistry	6	(3) MED/44, (3) CHIM/08

Activities of your choice

Courses in English are taught in English.

The student may take the exam in either English or Italian, at his or her own discretion.

TABLE B4

The student must choose 2 courses of his choice from 6 CFU (for a total of 12 CFU), choosing them in full freedom among all the courses activated by the University, as long as they are functional to the training project. The consistency of the choice with the training plan will be assessed by the Study Plans Commission.

The Teaching College recommends using the optional lessons listed in Table B4 or, if necessary, the Related and Integrative of Table B3.

Advanced methods in organic synthesis	6	CHIM/06
Advanced physical methods in organic chemistry	6	CHIM/06
Analytical technologies for the diagnostics of cultural heritage *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01
Bioinorganic Chemistry: Enzyme Systems and Investigation Methods *(Course activated in alternate years: inactive in 2025-2026, active in 2026-2027)*	6	CHIM/03
Bioorganic Chemistry	6	CHIM/06
Catalysis: Fundamentals and Applications for the Environment and the Circular Economy	6	CHIM/02
Catalytic Methodologies in Organic Synthesis	6	CHIM/06
Chemical-physical transformations of solids *(Course activated in alternate years: not active in 2025-2026, active in 2026-2027)*	6	CHIM/02
Chemistry of natural products	6	CHIM/06
Chemometrics	6	CHIM/01
Crystal chemistry	6	CHIM/02
Databases and Elements of Chemoinformatics	6	CHIM/06
Electrochemistry	6	CHIM/02
Electronic properties of advanced materials *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/02
Environmental Chemistry	6	CHIM/01
Environmental impact assessment: management of contaminants and analysis tools	6	CHIM/01
History of Chemistry and Elements of Didactics	6	CHIM/03
Homogeneous Catalysis: Industrial Applications	6	CHIM/03
Metallorganic Chemistry	6	CHIM/03
Methods in Chemical Biology	6	CHIM/06
Molecular modeling	6	CHIM/02
Molecular spectroscopy	6	CHIM/02
Nanoparticles: chemistry and applications	6	(3) CHIM/03, (3) CHIM/06

Photochemistry	6	CHIM/02
Photoluminescence and magnetic resonance: applications in inorganic and organometallic chemistry	6	CHIM/01
Physical-organic chemistry *(Activated starting from 2026/2027)*	6	CHIM/06
Plastics degradation and its environmental impact *(Course borrowed from LM Sustainable Industrial Chemistry)*	6	CHIM/04
Polymer science	6	CHIM/04
Quantum chemistry	6	CHIM/02
Simulation and modeling of biomolecules	6	CHIM/02
Solid state Chemistry *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/03
Supramolecular chemistry	6	CHIM/03
Synthesis and applications of inorganic materials	6	CHIM/03
Technology-driven organic synthesis	6	CHIM/06
Theoretical chemistry with elements of quantum computing	6	CHIM/02
Tools and techniques for the analysis of complex matrices *(Course activated in alternate years: active in 2025-2026, inactive in 2026-2027)*	6	CHIM/01