



Didactic Regulations of the Degree Course in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications

These Regulations govern the organization and functioning of the Degree Course in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications, belonging to the class of Degrees L-29, Pharmaceutical Sciences and Technologies, and entirely taught in English, activated at Sapienza University of Rome. According to the provisions of the University Didactic Regulations, these Regulations specify, in compliance with the freedom of teaching and the rights and duties of lecturers and students, the organizational and functional aspects of the Degree Course in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications.

Art. 1 - Specific training objectives of the Degree Course and reference professional profiles

1. Educational objectives

Accepting the suggestions of the social partners consulted in the course of conception and planning of the Degree Course, the course itself was articulated and elaborated in accordance with what emerged in the various informal and formal meetings, carried out electronically or on site, conducted by Prof. Botta and Mei di Sapienza and representatives of the (inter)national pharmaceutical industries and local authorities (for the minutes of the final meeting https://web.uniroma1.it/dip_ctf/en/teaching/studying-with-us/bachelor-single-cycle-degrees/molecular-biology-medicinal-chemistry-computer-science-pharmaceutical-applications). There are several Degree Courses in the L-29 class in Italy, but the Degree in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications is the only one totally in English in this class and the only one in the country that provides specific and in-depth training in three areas of fundamental importance, which promise to be the premises for a great innovation in the drug discovery process of the near future. From this point of view, the course specifically responds to a very broad and rapidly developing need in Italy, in Europe and throughout the world.

The graduates in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications will have a solid multi- and transdisciplinary cultural background and a solid formation in the three different cultural areas (Molecular Biology, Medicinal Chemistry and Computer Science) which in this educational process merge each other in a balanced, harmonious, and synergistic way. This preparation will allow graduates to understand and keep up with the continuous progress of technology and with the profound transformation of the biomolecular/pharmaceutical research area.

The graduates in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications will be able to access post-first graduate levels of study in the biomolecular, medicinal chemistry and applied informatics disciplines. Alternatively, the solid scientific and technical knowledge acquired will allow them to quickly enter the labor world (industries and research institutions), in the field of medicinal chemistry and biomolecular disciplines, even in the most innovative aspects related to the programming and use of information technologies.

As an added value, the Degree Course has a strong international vocation, and for this purpose it is delivered entirely in English. It aims to attract international students and to become a European reference point in a highly innovative training field such as biomolecular/pharmaceutical/technology information.

The objective of the Degree Course is to train qualified figures with a background in the field of advanced biomolecular, medicinal, pharmaceutical, and technological scientific research that synergistically integrates i) a solid set of theoretical skills in basic cultural disciplines, ii) broad skills in the biomolecular, medicinal chemistry, technological-applicative and IT fields and iii) critical capacity for scientific evaluation and skills in information and communication.

2. Knowledge and skills expected

A) Knowledge and understanding

The graduate in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications will acquire a knowledge of the scientific-methodological basis of his areas and domains of choice: pharmaceutical sciences (chemistry and technology), molecular biology and computer science. This knowledge will be acquired through lectures, exercises, laboratory activities carried out individually or in groups, or under the guidance of a tutor, as well as through project activities, typically carried out in groups. Verification of the achievement of this educational objective is obtained with ongoing assessments and final written and oral tests (exams). Numerous courses also provide for practical tests of the results of individual laboratory activities or design activities, typically to be carried out in a group, in analogy with what can occur in real work situations.

B) Ability to apply knowledge and understanding

The training course will enable the graduate to apply their knowledge and understanding to solve problems. These skills are generally developed through the understanding of some aspects of molecular biology, medicinal chemistry, and pharmaceutical technology also through the programming and development of algorithms in the fields of the aforementioned sciences, through the design and implementation of computer systems, and through the application of theoretical principles to real world problems. The verification of the ability to apply knowledge and understanding takes place through the final exams of the individual courses and, overall, through the internship activity and the final exam, that can be related or not to the internship activity, carried out under the supervision of a tutor.

The knowledge and skills will be achieved and verified in the following training activities related to the specific learning areas:

Mathematics, physics, chemistry, and statistics area

The three-year graduate will know the fundamental concepts of mathematics, physics, statistics, general and inorganic chemistry, organic chemistry, and food chemistry.

Biological, genetic, medical area

The graduate will acquire knowledge and understanding in terms of cultural skills related to biochemistry, molecular biology, pathology, immunology, and laboratory techniques for molecular biology.

Medicinal chemistry and pharmaceutical technology area

The three-year graduate will learn knowledge concerning the fundamental concepts of chemical biology, medicinal and pharmaceutical chemistry, drug delivery and targeting.

IT area

The graduate will learn knowledge related to programming, algorithm analysis, machine learning and computational biology.

C) Making Judgments

At the end of the training course, graduates in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications will have acquired the ability to autonomously interpret chemical, biomolecular, medicinal chemistry, pharmaceutical technology and IT knowledge and formulate their own critical judgments within a group of work, thus offering their own contribution to the advancement of activities. The development of students' judgment skills takes place both during lessons and exercises and in the context of laboratory activities and training internships. The assessment of judgment will take place through the exams, also *in itinere*, and the evaluation of the documentation produced to accompany the laboratory activities and the internship. In evaluating the internship activity, particular attention will be paid to how much the student has made an autonomous contribution to the solution, even and above all if the work has been carried out within a group including senior staff.

D) Communications skills

Students will acquire the ability to present and argue their ideas about the problems faced and the solutions proposed to both specialist and non-specialist interlocutors; to communicate effectively and discuss profitably with colleagues and users about problems relating to their area of professional competence. The development of communication skills will take place throughout the entire course of study, both during interviews between the student and the teachers, both within the groups that will carry out laboratory activities, and between the student and external interlocutors during the internship activity. The verification of these skills will take place through the evaluation of what will be expressed by the students in oral or written form both during the intermediate tests and the examination test of the individual courses and during the laboratory activities, the internship, and the final exam. Finally, it should be noted that the use of the English language throughout the entire course will allow graduates in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications to exercise communication skills also in international professional contexts.

E) Learning skills

The training course has, among others, the objective of developing the ability to deepen the methodological and technological aspects of the mathematical, physical, statistical, biomolecular, chemical and computer disciplines, so that the graduate understands the technological evolution and can adapt to the progress and integration of the disciplines covered in the training course. Furthermore, graduates will be able to undertake subsequent study cycles in the disciplines involved, also aimed at the development of research activities and will be able to continue their training, independently, thanks to the ability to effectively consult scientific documentation and technology and databases.

The development of learning skills takes place throughout the course of study: all the planned activities (lessons, exercises, laboratory activities alone or in a group, internship) contribute to the progressive increase of learning skills.

3. Professional profiles and employment opportunities

The decision to deliver curricular courses exclusively in English places the graduates in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications in a position to have access not only to the national, but also to the international (European and global) labor market.

At the end of the training course, graduates in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications can be placed in two different professional profiles, one more specifically dedicated to biochemical/biomolecular/biomedical knowledge and the second dedicated to medicinal and pharmaceutical chemistry and technological knowledge applications. In both professional profiles, an aspect of digital and IT innovation will be present in a transversal manner.

The two profiles are:

"Expert in biomolecular disciplines integrated with information technology", which presents as employment opportunities computer organizations or industries operating in the fields of software and hardware production for bioinformatics or medical-clinical applications; biomolecular/biomedical research institutions – both public and private - and health services; hospital centers, in the bioinformatics field, in support of scientific activities, and IT companies operating in the medical sector.

"Expert in medicinal/pharmaceutical chemistry disciplines integrated with information technology", for which the employment opportunities are represented by organizations or IT industries operating in the fields of software and hardware production for medicinal and pharmaceutical chemistry, food, nutraceutical and cosmeceutical applications; public and private medicinal/pharmaceutical chemistry and technological-application research groups, operating in the sector of identifying new biologically active compounds; hospital centers, in the medicinal/pharmaceutical chemistry sector, in support of scientific activities, and at IT companies operating in the medical/pharmaceutical sector.

Art. 2 – Access to the course

To be admitted to the Degree Course in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications it is necessary to have a secondary school diploma or other qualification obtained abroad, recognized as suitable. Basic knowledge of Physics, Mathematics, Biology and Chemistry which is normally provided by the first and second grade secondary school cycle of studies are important to successfully face the course of study. Logical and comprehension skills of written texts and speech are also required, as well as mastery of expression through writing. The students must have adequate knowledge of the English language. Enrollment in the degree program is subject to participation in an admission procedure based on the performance of tests to verify the possession of the knowledge and skills described above, including knowledge of the English language with a level of (at least) B2. The initial knowledge necessary to access the course is ascertained thanks to a standard entrance test, such as the ENGLISH TOLC-F (CISIA-Farmacia On Line Test) also in TOLC@CASA mode, which can be taken from 2020 also in English and which in any case has a section dedicated to linguistic competence in English and the SAT (Scholastic Assessment Test) General Test, managed by the College Board which can be taken at any of the SAT Centers in the world. Additional educational obligations (OFA) will be assigned to students who, despite having achieved a useful position in the merit ranking, have achieved a score of less than 3 points in the Mathematics questions of the ENGLISH TOLC-F or TOLC@CASA, or a Math Score below 343 in the SAT test. In relation to this obligation, the Faculty of Pharmacy and Medicine will organize remedial courses in the Mathematics subject. The dates and methods of carrying out the courses will be published on the Pharmacy and Medicine Faculty website (<https://web.uniroma1.it/farmaciamedicina/>) and on the institutional website of the Degree Course (https://web.uniroma1.it/dip_ctf/teaching/educational-offering/bachelor-and-master-degree-courses/molecular-biology-medicinal-chemistry-computer-science). Additional educational obligations (OFA) are deemed to be satisfied by passing either the related remedial test (OFA test) organized by the

Faculty, or the Mathematics exam. Failure to complete the OFA will make it impossible, starting from the 2023-2024 academic year, to sit exams relating to years after the first.

The CCL (Consiglio di Corso di Laurea, Degree Course Council) guarantees that all courses have a syllabus that clearly describes the knowledge necessary for course attendance and that the teaching material for the effective use of the courses is prepared and delivered by the teachers to the students. The courses organized as a laboratory are designed to stimulate the student's independence, the ability to work in a group, and the ability to organize one's work to meet the deadline for deliveries. The best students will have at their disposal the "way of excellence", an "honor way" that stimulates the most motivated students to give their best and deepen their knowledge in a multi- and transdisciplinary way. The Degree Course will make use of web and social methodologies to make the content of the lessons known day after day and allow students with special needs, such as working students or students who cannot follow all the lessons, to keep up with their studies. The CCL promotes, in concert with the Commission for Faculty Disabled Students, accessible websites and all measures to promote the attendance of disabled students. The training course provides for the choice of optional exams within the training areas: this makes it possible for the student to deepen some knowledge through the autonomous choice of these exams, making use of the support of the teaching staff.

Art. 3 - Organization of the Degree Course

The educational path of the Degree Course in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications is structured as follows:

1. in the first-year basic preparation is provided in chemical, biological, mathematical, statistical, physical and computer disciplines (51 CFU). The 12 credits chosen by the student (12 CFU) complete the first year.
2. in the second-year knowledge of the biological-medical and biomolecular disciplines is provided, as well as further knowledge in chemical and computer disciplines (60 CFU)
3. in the third-year computer training is completed, both in the area of computational biology and machine learning, and courses are offered in the disciplines of clinical biochemistry, pathology and immunology, biomolecular laboratory techniques, medicinal/pharmaceutical chemistry and pharmaceutical technology, the latter focused on drug delivery and specific targeting (42 CFU). The third year is completed by a compulsory training internship (3 CFU), an Advanced English Skills qualification test (6 CFU) and the graduation final exam (6 CFU).

The internship will be carried out under the guidance of an internal or external manager and in the latter case it can be carried out in companies or external bodies. In both cases, the internship requires the student to be offered a real-world problem, which she/he will have to solve through the elaboration of a project developed with a professional approach. Laboratory and/or planning activities or exercises can be carried out for all courses.

Art. 4 - Didactic plan

1. The didactic plan, defined in the following table, indicates all the training activities foreseen for the attainment of the Degree in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications, specifying whether they are basic, characterizing, similar or supplementary; it also indicates the disciplinary areas provided for by the legal system.
2. The various courses and other training activities can be activated directly or possibly borrowed from other Degree Courses of the Faculty and, where necessary, of the University, as well as, based on specific agreements, of other universities. Each teaching/training activity is structured in such a way as to fulfill

the training objectives assigned to it. The structure and articulation of each course and other training activities will be specified annually in the Manifesto degli Studi.

Basic training activities				
Disciplinary areas	Teachings	SSD	CFU	Number of exams
Mathematics, Physics, Informatics and Statistics disciplines	Experimental physics	FIS/01		5
	Physics		6	
	Informatics	INF/01		
	Introduction to programming and Laboratory		12	
	Design and analysis of algorithms		6	
	Machine learning and computational biology		6	
	Mathematical analysis	MAT/05		
	Mathematics		6	
Chemical disciplines	General and inorganic chemistry	CHIM/03		2
	Principles of general and inorganic chemistry <i>Principles of general and inorganic chemistry I</i>		3	
	<i>Principles of general and inorganic chemistry II</i>		3	
	Organic chemistry	CHIM/06		
	Organic chemistry		6	
	Medicinal Chemistry	CHIM/08		
	Fundamentals of chemical biology <i>Fundamentals of chemical biology I</i>		3	
Biological and morphological disciplines	Biochemistry	BIO/10		2
	Fundamentals of chemical biology <i>Fundamentals of chemical biology II</i>		3	
	General biochemistry		6	
	Biochemistry and clinical biochemistry <i>Biochemistry</i>		9	

Characterizing training activities				
Disciplinary areas	Teachings	SSD	CFU	Number of exams
Pharmaceutical and Technological Disciplines	Medicinal Chemistry	CHIM/08		3
	Principles of Medicinal Chemistry		6	
	Medicinal Chemistry	9		
	Technological Pharmaceutical Application	CHIM/09		
	Bioactive compound delivery and targeting		12	
Chemical Disciplines	Organic Chemistry	CHIM/06		1
	Chemistry of food and natural compounds <i>Chemistry of food natural compounds</i>		6	
	Food Chemistry	CHIM/10		
	Chemistry of food and natural compounds <i>Chemistry of food</i>		6	
Biological Disciplines	Molecular Biology	BIO/11		2
	Molecular biology and applied molecular biology laboratory <i>Molecular biology and applied molecular biology laboratory I</i>		6	
	<i>Molecular biology and applied molecular biology laboratory II</i>	6		
	Clinical biochemistry and clinical molecular biology	BIO/12		
	Biochemistry and clinical biochemistry <i>Clinical biochemistry and molecular biology</i>		3	
Medical Disciplines	General Pathology	MED/04		1
	Pathology, immunology, and molecular biology techniques <i>General pathology and immunology</i>		6	
	Technical Sciences of Laboratory Medicine	MED/46		
	Pathology, immunology, and molecular biology techniques <i>Advanced molecular</i>		6	

	<i>biology techniques</i>			
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Related or supplementary training activities				
Disciplinary areas	Teachings	SSD	CFU	Number of exams
Related or supplementary training activities	Genetics	BIO/18		2
	Genetics		9	
	Statistics	SECS-S/01		
	Statistics		9	

Art. 5 - Description of the training course, courses, and related scientific-disciplinary sectors

1. Articulation of the training path of the Degree Course in Molecular Biology, Medicinal Chemistry and Computer Science for Pharmaceutical Applications:

First Year			
Code	Name	Features	Certificate
10602985	INTRODUCTION TO PROGRAMMING AND LABORATORY	12 cfu in A - Mathematics, Physics, Informatics and Statistics disciplines INF/01	AP
10603022	MATHEMATICS	6 cfu in A - Mathematics, Physics, Informatics and Statistics Disciplines MAT/05	AP
10604519	PRINCIPLES OF GENERAL AND INORGANIC CHEMISTRY		AP
	<i>Module: PRINCIPLES OF GENERAL AND INORGANIC CHEMISTRY II</i>	3 cfu in A - Chemical Disciplines CHIM/03	
	<i>Module: PRINCIPLES OF GENERAL AND INORGANIC CHEMISTRY I</i>	3 cfu in A - Chemical Disciplines CHIM/03	
10607290	FUNDAMENTALS OF CHEMICAL BIOLOGY		AP
	<i>Module: FUNDAMENTALS OF CHEMICAL BIOLOGY I</i>	3 cfu in A - Chemical Disciplines CHIM/08	
	<i>Module: FUNDAMENTALS OF CHEMICAL BIOLOGY II</i>	3 cfu in A - Biological and Morphological Disciplines BIO/10	
10602987	ORGANIC CHEMISTRY	6 cfu in A - Chemical Disciplines CHIM/06	AP
10602988	STATISTICS	9 cfu in C - Related or supplementary training activities SECS- S/01	AP
10595523	PHYSICS	6 cfu in A - Mathematics, Physics, Informatics and Statistics Disciplines FIS/01	AP
-	ELECTIVE COURSES	12 cfu in D – Two courses chosen by students	AP

Second Year			
Code	Name	Features	Certificate
10602989	DESIGN AND ANALYSIS OF ALGORITHMS	6 cfu in A - Mathematics, Physics, Informatics and Statistics Disciplines INF/01	AP
10602990	GENERAL BIOCHEMISTRY	6 cfu in A - Biological and Morphological Disciplines BIO/10	AP
10607281	MOLECULAR BIOLOGY AND APPLIED MOLECULAR BIOLOGY LABORATORY <i>Module: MOLECULAR BIOLOGY AND APPLIED MOLECULAR BIOLOGY LABORATORY I</i>	6 cfu in B - Biological Disciplines BIO/11	AP
	<i>Module: MOLECULAR BIOLOGY AND APPLIED MOLECULAR BIOLOGY LABORATORY II</i>	6 cfu in B - Biological Disciplines BIO/11	
10605991	BIOCHEMISTRY AND CLINICAL BIOCHEMISTRY <i>Module: BIOCHEMISTRY</i>	9 cfu in A - Biological and Morphological Disciplines BIO/10	AP
10603012	GENETICS	9 cfu in C - Related or supplementary training activities BIO/18	AP
10607291	CHEMISTRY OF FOOD AND NATURAL COMPOUNDS		AP
	<i>Module: CHEMISTRY OF FOOD</i>	6 cfu in B - Chemical Disciplines CHIM/10	
	<i>Module: CHEMISTRY OF FOOD NATURAL COMPOUNDS</i>	6 cfu in B - Chemical Disciplines CHIM/06	
10607286	PRINCIPLES OF MEDICINAL CHEMISTRY	6 cfu in B - Pharmaceutical and Technological Disciplines CHIM/08	AP

Third Year			
Code	Name	Features	Certificate
10602994	MACHINE LEARNING AND COMPUTATIONAL BIOLOGY	6 cfu in A - Mathematics, Physics, Informatics and Statistics Disciplines INF/01	AP
AAF2225	INTERNSHIP ACTIVITIES	6 cfu in E - For Advanced English Skills, 3 cfu in F for Internship Activity	I
10604043	PATHOLOGY IMMUNOLOGY AND MOLECULAR BIOLOGY TECHNIQUES		AP
	<i>Module: GENERAL PATHOLOGY AND IMMUNOLOGY</i>	6 cfu in B - Medical Disciplines MED/04	
	<i>Module: ADVANCED MOLECULAR BIOLOGY TECHNIQUES</i>	6 cfu in B - Medical Disciplines MED/46	
10605991	BIOCHEMISTRY AND CLINICAL BIOCHEMISTRY <i>Module: CLINICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY</i>	3 cfu in B - Biological Disciplines BIO/12	AP

10602999	MEDICINAL CHEMISTRY	9 cfu in B - Pharmaceutical and Technological Disciplines CHIM/08	AP
10603000	BIO-ACTIVE COMPOUND DELIVERY AND TARGETING	12 cfu in B - Pharmaceutical and Technological Disciplines CHIM/09	AP
AAF2011	FINAL EXAM	6 cfu in E – For the Final Exam	AP

2. Graduation, final exam

Having acquired the necessary 174 credits (CFUs), in compliance with the resolutions in force, the student is allowed to take the final exam for the achievement of the degree. The final exam consists in the drafting, presentation (with ppt slides) and discussion of a written thesis, developed independently by the student, which documents in an organic and detailed way the subject matter or, if it is an experimental thesis, the problem of research addressed, possibly also starting from the period of the internship activity. Thesis documents the individual compilation or experimental work experimental work of the student which is performed under the guidance of a tutor teacher. It can be expected that part of the internship CFUs can be acquired through experiences in work environments that provide specific theoretical and technical skills. With the aforementioned research and/or training internship, the student acquires knowledge of the methodology, analytical tools and data analysis and processing techniques and must prepare an experimental thesis that brings an original contribution to scientific knowledge in the field. The final exam (6 CFU) consists in the discussion of the thesis prepared by the student. The thesis is expected to be written and discussed in English. The discussion takes place in front of the Graduation Commission which is appointed by the Dean and which, based on the student's career and the evaluation of the discussion, establishes the graduation grade. The Degree mark assigned by the Degree Commission in public session considers the student's entire course of study. The admission mark to the Degree exam is given by the arithmetic average of the marks of all exams. At the time of graduation, the Graduation Commission may add to the admission grade, based on the evaluation of the efforts made and the quality of the exposure, up to a maximum of 7 points for the compilation thesis and 11 points for the experimental thesis. Honors may be proposed by the supervisor only if the overall score of 110/110 is reached and must be unanimously approved by the members of the Degree Commission.

3. Methods of credit recognition

For the recognition of CFUs in cases of transfer from another university or transition from another university course of study, the provisions of the University didactic regulations apply. The Academic Board decides on a case-by-case basis whether forms of verification of earned credits and any supplementary exams should be envisaged. For the recognition of study activities carried out abroad and the related CFU, the provisions of the University Didactic Regulations apply.

Art. 6 - Organization of Quality Assurance

The course manager will be committed to managing teaching according to quality criteria defined, consistently with European standards and criteria, by the ENQA Guidelines. The presence of a quality assurance unit is foreseen for the course of study, which will be composed of the president of the course of study and associated or full professors, researchers, RTDA or RTDB, an administrative and a representative of the students. The following indicators are considered in Quality Assurance:

- 1) Efficiency in the use of teaching staff, evaluating the actual average annual commitment per teacher and the average annual number of credits acquired per student.
- 2) Evaluation of congruity between lesson times and structures (such as classrooms and laboratories).
- 3) Processing of the results relating to the students enrolled in the first year of the course and efficiency in terms of the number of students enrolled and attending the course of study.
- 4) Elaboration of the results of the training process.
- 5) Elaboration of students' opinions on teaching and other training activities, and opinions of undergraduates on the training process as a whole; elaboration of the results relating to the placement in the world of work or the continuation of graduate studies.
- 6) Evaluation of the regularity of the training courses measured, with reference to homogeneous study courses, through the dropout rate between the first and second year, the average annual number of credits acquired per student and the annual percentage of graduates within the timeframe set for the course study.