DIDACTIC REGULATIONS FOR THE DEGREE COURSE INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

ACRONYMS

CCD	[Commissione di Coordinamento Didattico]	Didactic Coordination Commission
CdS	[Corso/i di Studi]	Degree Course
CPDS	[Commissione Paritetica Docenti-Studenti]	Joint Teachers-Students Committee
OFA	[Obblighi Formativi Aggiuntivi]	Additional Educational Obligations
SUA-CdS	[Scheda Unica Annuale del Corso di Studi]	Annual Single Course Schedule
RDA	[Regolamento Didattico di Ateneo]	University Didactic Regulations

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Art. 1
Object

1. These Regulations govern the organisational aspects of the Degree Course in Industrial and Molecular Biotechnology (class LM-8). The Degree Course in Industrial and Molecular Biotechnology belongs to the Department of Chemical Sciences.
3. The CdS is governed by the Didactic Coordination Commission (CCD), pursuant to Art. 4 of the RDA.
4. The Rules are issued in compliance with the relevant legislation in force, the Statute of the University of Naples Federico II and the University Didactic Regulations.

Art. 2
Learning objectives

The educational objectives of the CdS are in accordance with the qualifying educational objectives of the LM-8 class. The Master Degree in Molecular and Industrial Biotechnology has the objective of training graduates with adequate knowledge in professional activities of research and production of goods and services in the various sectors of industrial biotechnology, applying the experimental scientific method as a basic approach to biotechnology disciplines and aiming to establish a broader approach to industrial biotechnology issues, aimed at achieving a higher level of professional awareness. The Master Degree in Molecular and Industrial Biotechnology integrates knowledge in the biological field with knowledge more properly aimed at industrial applications, also from an economic optimization point of view.
The CdS is structured in two years, each divided into two semesters: from the first to the fourth semester the student progressively matures the fundamental knowledge of the professional profile, passing from the deepening of biological methodologies, microbiological, biochemical and genetic methods for the industrial development of processes biotechnology, to complete the course with professionalizing educational activities (e.g. economics). The course is articulated in curricula that share a group of fundamental teachings for the formation of the industrial biotechnologist (e.g. the chemistry of fermentation) but that allow to finalize a differentiated training of the graduate by the type of skills offered, specific and professionalizing in the different areas of the labor market today available to graduates.
Consistent with the variety of job opportunities, the courses offered in the curricula will allow graduates to work in the field of consolidated industrial biotechnology (e.g. production processes of microorganisms and/or enzymes, environmental bioremediation) and in the field of emerging industrial biotechnology (e.g. exploitation of natural resources for the sustainable production of goods and services). Curricular courses dedicated to training in the field of emerging industrial biotechnology will be held in English.
The acquisition of knowledge, indicated in detail in the European Descriptors, is ascertained through interviews, ongoing tests and examinations aimed at evaluating the training process proposed by the Degree Programme.

Art. 3
Professional profile and work opportunities

Function in a work context:
Graduates in Molecular and Industrial Biotechnology will find a job in research and development laboratories in public and private institutions and in the chemical, pharmaceutical, food and biotechnology industries. The functions are to be framed in the field of innovation, development, design and management of biotechnological systems and processes. In particular, design,

development and control of industrial fermentation processes for the production of primary and secondary metabolites and for the production of energy carriers and chemicals obtained from renewable resources; development and control of processes for environmentally friendly chemistry; design, development and control of production processes of intermediates and products for fine chemistry and for the agri-food industry with biotechnological approaches (use of cells or parts thereof, or biomolecules); design, development and quality control of biological reagents; design, development and control of new biotechnological drugs. In addition, Master's graduates will be able to have service management functions in areas related to industrial biotechnology, such as in certification analysis laboratories and biological control, environmental monitoring services, in the facilities of the National Health Service. They will be able to operate, in the fields of their acquired specialization, with functions of high responsibility, taking into account the ethical, technical and legal aspects, as well as collaborate in technical-economic consulting companies aimed at biotechnological processes.

Skills associated with the function:

In all the professional fields described above, multidisciplinary knowledge and skills are required that the graduate acquires by integrating disciplines such as chemistry and biotechnology of fermentation, biochemistry, molecular biology and genetics, process technologies, thermodynamics and transport phenomena, enzymology and industrial microbiology economic and management. Thanks to the multidisciplinary training offered by the CDS, the graduate is able to acquire the spectrum of theoretical and practical skills necessary to perform the functions mentioned above.

Job opportunities in the sector:

Researchers and specialists in laboratories and public and private research and development bodies, in the chemical industries,

pharmaceutical, food, biotechnological, environmental rehabilitation, in national and international institutions of certification and development of legislation in the field of biotechnology, in service centers in the fields related to industrial biotechnology.

Art. 4

Admission requirements and knowledge required for access to the Degree Course[1]

Admission requires a degree which provides sufficient knowledge in the following disciplines:

a) mathematical, chemical and physical disciplines;

b) biological disciplines (biochemistry, molecular biology, genetics);

c) disciplines in the fermentation sector (microbiology and fermentation chemistry);

d) disciplines of process technologies (thermodynamics and transport phenomena, fundamentals of unified operations for biotechnology).

The student needs to have already earned required ECTs, in specific SSDs, as follows:

a) at least 24 ECTs within SSD Area 05 - Biological Sciences (BIO/01-BIO/19)

b) at least 6 ECTs in Area 01 SSD (MAT/01-MAT/09)

c) at least 6 ECTs in Area 02 - Physical Sciences (FIS/01-FIS/08)

d) at least 16 ECTs within SSDs falling under Area 03 - Chemical Sciences (CHIM/01-CHIM/12)

The curricular requirements and the adequacy of the personal preparation for admission are ascertained by examination of the graduate's university career and/or interview, according to methods defined in the Teaching Regulations of the CdS.

English - documented competence to use English correctly (in written and oral form) comparable to level B2.

[1] Artt. 7, 10, 11 of the University Didactic Regulations.

Art. 5
Procedures for access to the Degree Course

The verification of personal preparation is mandatory in any case, and can be accessed only by students with the requisite curriculum.

The verification of previous knowledge and personal preparation is entrusted by the CCD to the 'Access Commission to the Master's Degree' (CALM) - appointed by the CCD - which evaluates the student's career through possible individual interviews. If the CALM considers the level of knowledge and skills of the graduate sufficient, it expresses a judgment of suitability, which allows the matriculation to the Master of Science in Molecular and Industrial Biotechnology.
If the Graduate's preparation is assessed as unfit, the CALM identifies the knowledge that the student must acquire before matriculation. CCD teachers, if necessary, carry out preparatory training activities for the acquisition of the knowledge required for students of non-automatic matriculation.
The CCD periodically identifies Degree Programmes characterized by educational offer that meets the required entry requirements. The previous knowledge and preparation of the Graduates of the Degree Programmes thus identified meet the required entry requirements and therefore these Graduates will be able to access the LM without further verification.

Art. 6
Teaching activities and Credits

Each educational activity prescribed by the degree system is measured in Credits. Each Credit corresponds to 25 hours of work[2] per student and includes the hours of assisted teaching and the hours reserved for personal study or other individual training activities.
For the Degree Course covered by these Regulations, the hours of assisted teaching for each ECT, established in relation to the type of training activity, are as follows [3]:

- Lecture: 8 hours for ECT;
- Seminar: 4 hours for ECT;
- Guided teaching exercises: 12 hours per ECT;
- Laboratory activities: 12 hours per ECT;
- Internship: 25 hours for ECT [4].

The ECT corresponding to each learning activity is acquired by the student by satisfying the assessment procedures (examination, pass mark) indicated in the Schedule relating to the course/activity attached to these Regulations.

Art. 7
Description of teaching methods

Teaching is carried out in a conventional way.

[2] According to Art. 5, c. 1 of Italian Ministerial Decree No 270/2004, "25 hours of total commitment per student correspond to university training credits; a ministerial decree may justifiably determine variations up or down the aforementioned hours for individual classes, within the limit of 20 per cent".
[3] The number of hours considers the instructions in Art. 6, c. 2 of the RDA: "of the total 25 hours, for each ECT, are reserved: a) 5 to 10 hours for lectures; b) 6 to 10 hours for seminars; c) 8 to 12 hours for laboratory activities, except in the case of training activities with a high experimental or practical content, and subject to different legal provisions or different determinations by DD.MM.".
[4] For Internship activities (Inter-ministerial Decree 142/1998), subject to further specific provisions, the number of working hours equal to 1 ECT may not be less than 25. [please indicate below in the note any different regulatory provisions, e.g., "LM-13: 1 ECT = 30 hours, Note MUR, Director Cuomo, Prot. 570/2011; LM-51, L-24: 1 CFU = 20 hours professional training activity + 5 hours of further supervised training activity, D.M. 654/2022 (Art. 2, practical-assessment Internship)"]

If necessary, the CCD decides which class may also include teaching activities offered online.

Some lectures may also take place in seminar form and/or involve classroom exercises, language and computer laboratories.

Detailed information on how each course is done can be found on the course website.

Art. 8
Testing of learning activities[5]

1. The Didactic Coordination Commission, within the regulatory limits laid down[6], establishes the number of examinations and other means of assessment that determine the acquisition of credits. Examinations are individual and may consist of written, oral, practical, graphical tests, term papers, interviews or a combination of these modes.
2. The examination procedures published in the teaching schedules and the examination schedule will be made known to students before the start of classes on the Department's website.
3. Examinations are held subject to booking, which is made electronically. In the event that the student is unable to book an exam for reasons that the President of the Board considers justified, the student may still be admitted to the examination, following the other booked students.
4. Before the examination, the President of the Board of Examiners verifies the identity of the student, who must present a valid photo ID.
5. Examinations are marked out of 30. Examinations involving an assessment out of 30 shall be passed with a minimum mark of 18; a mark of 30 may be accompanied by honours by unanimous vote of the Board. Examinations are marked out of 30 or with a simple pass mark. Assessment following tests other than examinations are marked out with a simple pass mark.
6. Oral exams are open to the public. If written tests are scheduled, the candidate has the right to see his/her paper(s) after correction.
7. Examination Boards are governed by the University Didactic Regulations.

Art. 9
Course structure and syllabus

1. The legal duration of the Degree Course is 2 years. It is also possible to enrol on the basis of a contract in accordance with the rules laid down by the University (Art. 21 of the University Didactic Regulations).
   The student must acquire 120 ECTs[7] , attributable to the following Types of Educational Activities (TAF):
   B) characterising, 75
   C) related or complementary, 12
   D) at the student's choice[8] , 12
   E) for the final exam, 3
   F) further training activities, 18.

[5] Article 20 of the University Didactic Regulations.
[6] Pursuant to the DD.MM. 16.3.2007 in each Degree Course the examinations or profit tests envisaged may not be more than 20 (bachelor's degrees; Art. 4. c. 2), 12 (master's degrees; Art. 4, c. 2), 30 (five-year single-cycle degrees) or 36 (six-year single-cycle degrees; Art. 4, c. 3).
[7] The total number of ECTs for the acquisition of the relevant degree must be understood as follows: six-year single-cycle degree, 360 ECTs; five-year single-cycle degree, 300 ECTs; three-year degree, 180 ECTs; master's degree, 120 ECTs.
[8] Corresponding to at least 12 ECTs for three-year degrees and at least 8 ECTs for master's degrees (Art. 4, c. 3 of Ministerial Decree 16.3.2007).

2. The degree is awarded after having acquired 120 ECTs by passing examinations, not exceeding 12, including the final exam, and the performance of the other educational activities.
   Unless otherwise provided for by the legal system of university studies, examinations taken as part of basic, characterising and related or supplementary activities, as well as activities chosen autonomously by the student (TAF D, counted in the number of one[9]) are taken into consideration for counting purposes. Tests constituting an assessment of suitability for the activities referred to in Article 10, paragraph 5, letters c), d) and e) of Ministerial Decree 270/2004 are excluded from the count. Integrated courses comprising two or more modules are subject to a single examination.
3. In order to acquire the ECTs relating to independent choice activities, the student is free to choose from all the courses offered by the University, provided that they are consistent with the training project. This consistency is assessed by the Didactic Coordination Commission. Also for the acquisition of the ECTs relating to autonomous choice activities the "passing of the exam or other form of profit verification" is required (Art. 5, c. 4 of Ministerial Decree 270/2004[10]).
4. The study plan summarises the structure of the course, listing the envisaged teachings broken down by course year and, if necessary, by curriculum. At the end of the study plan table the propedeuticities envisaged by the course are listed. The plan of studies offered to students, with an indication of the scientific-disciplinary sectors and the area to which they belong, of the credits, of the type of teaching activity, is set out in Annex 1 to these Regulations.

Art. 10
Attendance requirements[11]

1. In general, attendance at frontal lessons is strongly recommended but not mandatory

In view of the type of educational organisation provided for in this Regulation, compulsory attendance at all training activities may be required. In particular, for courses that include laboratory activities, attendance at least 70% of them is a prerequisite for access to the evaluation. For courses in which the verification of profit includes ongoing assessments, with tests to be carried out during the course, the prerequisite to access the assessment is to have carried out at least 70% of the tests.

2. If the lecturer envisages a different syllabus modulation for attending and non-attending students, this is indicated in the individual Teaching Schedule published on the course web page and on the teachersUniNA website.
3. Attendance at seminar activities that award training credits is compulsory. The relative modalities for the attribution of ECTs are the responsibility of the CCD.

[9] Art. 4, c. 2 of Annex 1 to Ministerial Decree 386/2007.

[10] Art. 10, c. 5 of Ministerial Decree. 270/2004: "In addition to the qualifying educational activities, as provided for in paragraphs 1, 2 and 3, Degree Courses shall provide for: a) educational activities autonomously chosen by the student as long as they are consistent with the training project [TAF D]; b) educational activities in one or more disciplinary fields related or complementary to the basic and characterising ones, also with regard to context cultures and interdisciplinary training [TAF C]; c) educational activities related to the preparation of the final exam for the achievement of the degree and, with reference to the degree, to the verification of the knowledge of at least one foreign language in addition to Italian [TAF E]; d) training activities, not envisaged in the previous points, aimed at acquiring additional language knowledge, as well as computer and telematic skills, relational skills, or in any case useful for integration in the world of work, as well as training activities aimed at facilitating professional choices, through direct knowledge of the work sector to which the qualification may give access, including, in particular, training and guidance courses referred to in Decree no. 142 of 25 March 1998 of the Ministry of Labour [TAF F]; e) in the hypothesis referred to in Article 3, paragraph 5, training activities relating to internships and apprenticeships with companies, public administrations, public or private entities including those of the third sector, professional orders and colleges, on the basis of appropriate agreements".

[11] Art. 20, c. 8 of the University Didactic Regulations.

Art. 11
Prerequisites and prior knowledge

1. The list of incoming prerequisites (necessary to sit a particular examination) and outgoing prerequisites can be found at the end of Annex 1 and in the Teaching Schedule (Annex 2).
2. Any prior knowledge deemed necessary is indicated in the individual Teaching Schedule published on the course webpage and on theUniNA teaching website.

Art. 12
Course Calendar

The course calendar is made available on the Department's website and on the CdS's website prior to the start of classes.

Art. 13
Guidelines for the recognition of credits earned in other Courses in the same Class[12]

For students coming from Courses in the same Class, or simultaneously enrolled in Degree Courses of the same Class, the Didactic Coordination Commission shall ensure the recognition of the highest possible number of credits acquired by the student at the Course of origin and/or simultaneously attended, according to the criteria set out in Article 14 below. Failure to recognise credits must be adequately justified. This is without prejudice to the fact that the number of credits relating to the same scientific-disciplinary sector directly recognised to the student may not be less than 50% of those already achieved.

Article 14
Guidelines for the recognition of credits acquired in Degree Courses of different classes, in university or university-level Degree Courses, through single courses, at online Universities and in international Degree Courses[13]; Guidelines for the recognition of credits acquired in extra-curricular activities

1. With regard to the criteria for the recognition of ECTs acquired in Degree Courses of different Class, in university or university-level Degree Courses, through single courses, at online Universities and in International Degree Courses, the credits acquired are recognised by the competent structure on the basis of the following criteria:
   - analysis of the programme carried out;
   - evaluation of the congruity of the disciplinary scientific sectors and of the contents of the training activities in which the student has earned credits with the specific training objectives of the Course of Studies and of the individual training activities to be recognised.

   Recognition is carried out up to the amount of credits envisaged by the didactic system of the Degree Course. Failure to recognise credits must be adequately justified.
2. The possible recognition of ECTs relating to examinations passed as single courses may take place within the limit of 36 ECTs, upon request of the interested party and following the approval of the competent teaching structures. Recognition may not contribute to the reduction of the legal duration of the Degree Course, as determined by Art. 8, c. 2 of Ministerial Decree 270/2004, except for students who enrol while already in possession of a degree of the same level[14].
3. With regard to the criteria for the recognition of ECTs acquired in extra-curricular activities, within the limit of 12 ECTs the following activities may be recognised:

[12] Art. 16 of the University Didactic Regulations.
[13] Art. 16 of the University Didactic Regulations.
[14] R.D. No. 3241/2019.

- Professional knowledges, skills and certified skills, taking into account the congruence of the activity carried out and/or of the certified skill with the aims and objectives of the Degree Course of enrolment as well as the hourly commitment of the duration of the activity.
- Knowledges and skills acquired in post-secondary-level training activities, which the University contributed to develop and implement.

Art. 15
Guidelines for enrolment in individual Degree Courses

Enrolment in individual teaching courses, provided for by the University Didactic Regulations[15], is governed by the "University Regulations for enrolment in individual teaching courses activated as part of the Degree Courses "[16].

Article 16
Features and arrangements for the final examination

The final exam consists in the discussion of a written thesis, written in an original way by the student and referring to an experimental activity carried out under the guidance of one or more supervisors. In addition, the candidate will have to prepare a short document summarizing the work done, to be sent to the members of the Master Degree Commission.
The written document may also be drawn up in English. In this case, an extract in the Italian language shall be attached to it.
Part of the preparatory work for the final exam can take place within an internship activity. Therefore, part of the credits that would otherwise have been assigned to the final test is attributed to the latter activity.
To access the final exam, the student must have acquired the number of credits provided by the teaching regulations, less those provided for the final exam.
The final exam is a public discussion of the paper before the Degree Examination Commission. The presentation is an important demonstration of the cultural maturity achieved by the student and his ability to independently and critically elaborate the subject. The final test usually involves the presentation by means of audiovisual systems (usually in English) of the activity carried out: introduction to the experimental problem, purpose of the experiment, methods used, results obtained, discussion of the results. The presentation is usually in Italian. The candidate is asked to discuss the work carried out with the Commission in order to highlight the mastery of the subject. The paper will deal with a theme related to one of the basic scientific-disciplinary fields, characterizing, similar or integrative, or, in any case, consistent with the educational objectives of the CdS. At the end of the presentation, each Member of the Commission may submit observations to the candidate on the subject of thesis work. The assessment of the candidate is also based on the presentation of the paper and the subsequent discussion, taking into account communication skills, learning skills and judgment autonomy.

Article 17
Guidelines for work internships and placements

1. Students enrolled in the CdS may decide to carry out internships or training periods with organisations or companies that have an agreement with the University. Internships are

[15] Art. 16, c. 6 of the University Didactic Regulations.
[16] R.D. No. 3241/2019.

compulsory, and contribute to the award of credits for the other educational activities chosen by the student and included in the study plan, as provided for by Art. 10, par. 5, letters d and e, of Ministerial Decree 270/2004[17].

2. The modalities and characteristics of internships and placements are regulated by the CCD with a specific regulation.
3. The University of Naples Federico II, through the structures of the University, School, Department, ensures constant contact with the world of work, in order to offer students and graduates of the University concrete opportunities for internships and work experience and to promote their professional integration.

Article 18
Disqualification of student status[18]

A student who has not taken any examinations for eight consecutive academic years incurs forfeiture, unless his contract stipulates otherwise. In any case, forfeiture shall be notified to the student by certified e-mail or other suitable means attesting to its receipt.

Article 19
Teaching tasks, including supplementary teaching, guidance and tutoring activities

1. Lecturers and researchers carry out the teaching load assigned to them in accordance with the provisions of the University Teaching Regulations and the Regulations on the teaching and student service duties of professors and researchers and on the procedures for self-certification and verification of actual performance[19].
2. Professors and researchers must guarantee at least two hours of reception every 15 days (or by appointment in any case granted no longer than 15 days) and in any case guarantee availability by e-mail.
3. The tutoring service has the task of guiding and assisting students throughout their studies and of removing the obstacles that prevent them from adequately benefiting from attending courses, also through initiatives tailored to the needs and aptitudes of individuals.
4. The University ensures guidance, tutoring and assistance services and activities to welcome and support students. These activities are organised by These activities are organized by the Polytechnic School and Basic Sciences in collaboration with the individual Teaching Structures, as established by the RDA in Article 8.

Article 20
Evaluation of the quality of the activities performed

1. The Didactic Coordination Commission implements all the forms of quality assessment of teaching activities envisaged by the regulations in force according to the indications provided by the University Quality Presidium.
2. In order to guarantee the quality of teaching to the students and to identify the needs of the students and all stakeholders, the University of Naples Federico II uses the Quality Assurance (QA)[20] system, developed in accordance with the document "Self-evaluation, Evaluation and Accreditation of the Italian University System" of ANVUR, using:

[17] Letter d traineeships can be both internal and external; letter d traineeships and placement can only be external.
[18] Art. 21 of the University Didactic Regulations.
[19] R.D No. 2482//2020.
[20] The Quality Assurance System, based on a process approach and adequately documented, is designed in such a way as to identify the needs of the students and all stakeholders, and then translate them into requirements that the training offer must meet.

- surveys on the degree of integration of graduates into the world of work and on post-graduate needs.
- data extracted from the administration of the questionnaire to assess student satisfaction for each course in the curriculum, with questions relating to the way the course is conducted, teaching materials, teaching aids, organisation, facilities.

The requirements deriving from the analysis of student satisfaction data, discussed and analysed by the Teaching Coordination Committee and the Joint Teachers' and Students' Committee (CPDS), are included among the input data in the service design process and/or among the quality objectives.

3. The QA organisation developed by the University implements a process of continuous improvement of the objectives and of the appropriate tools to achieve them, ensuring that planning, monitoring and self-assessment processes are activated in all the structures to allow the prompt detection of problems, their adequate investigation and the design of possible solutions.

Article 21
Final Rules

The Department Council, on the proposal of the Academic Coordination Committee, submits any proposals to amend and/or supplement these Rules for consideration by the Academic Senate.

Article 22
Publicity and Entry into Force

1. These Rules and Regulations shall enter into force on the day following their publication on the University's official notice board; they shall also be published on the University website. The same forms and methods of publicity shall be used for subsequent amendments and additions.
2. Annex 1 (CdS structure) and Annex 2 (Teaching/Activity schedule) are an integral part of these Regulations.

ANNEX 1.2

COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

STUDY PLAN A.Y. 2023-2024

KEY

Type of Educational Activity (TAF):
B = Characterising
C = Related or Supplementary
D = Optional activities
E = Final examination and language knowledge
F = Further training activities

Curriculum Biotechnology Productions (Probio)
(in italics the characteristic teachings of the curriculum)

Title Teaching	SSD	Module	Credits	Hours	Type Activities	TAF	Course Modalities	Disciplinary area	Mandatory/ optional
Year I									
Industrial microbial biotechnology	CHIM/11	Single	6	52	Frontal lessons, exercises and laboratory	B	In-presence	Chemical disciplines	Mandatory
Systems Biology and Bioinformatics	BIO/10	*Systems biology*	6	48	Frontal lessons	B	In-presence	Biological disciplines	Mandatory
	BIO/10	*Bioinformatics and molecular modelling*	6	48	Frontal lessons	B	In-presence	Biological disciplines	Mandatory
Industrial and environmental biotechnology	BIO/11	Industrial Biotechnology	6	48	Frontal lessons	B	In-presence	Biological disciplines	Mandatory
	AGR/07	Biotechnology for the protection of the environment	6	48	Frontal lessons	C	In-presence		Mandatory
Transport phenomena in biological systems	ING-IND/24	Single	9	72	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
Biochemical biotechnology	BIO/10	*Recombinant biotechnology*	6	52	Frontal lessons, exercises and laboratory	B	In-presence	Biological disciplines	Mandatory

Title Teaching	SSD	Module	Credits	Hours	Type Activities	TAF	Course Modalities	Disciplinary area	Mandatory/ optional
	BIO/10	*Protein and metabolic engineering*	6	48	Frontal lessons	B	In-presence	Biological disciplines	Mandatory
Bioreactors	ING-IND/25	*Single*	6	48	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
Year II									
Biotechnological processes	ING-IND/26	*Theory of the development of biotechnological processes*	6	48	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
	ING-IND/25	*Biotechnological plants and processes*	6	48	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
Hygiene principles in biotechnology	MED/42	Single	6	48	Frontal lessons	C	In-presence		Mandatory
Biochip and biosensors	FIS/01	Single	6	48	Frontal lessons	B	In-presence	Disciplines for professional skills	Mandatory
Bioeconomy and intellectual property	ING-IND/35	Single	6	48	Frontal lessons	B	In-presence		Mandatory
Independent choice of training activities student's			12 (+)		Frontal lessons	D			Mandatory
Training and orientation to the world of work			18			F			
Final test			3			E			

Curriculum Biotechnology for Renewable Resources (BiRRe)

(in italics the characteristic teachings of the curriculum)

Title Teaching	SSD	Module	Credits	Hours	Type Activities	TAF	Course Modalities	Disciplinary area	Mandatory/ optional
Year I									
Industrial microbial biotechnology	CHIM/11	Single	6	52	Frontal lessons, exercises and laboratory	B	In-presence	Chemical disciplines	Mandatory
Microalgal exploitation	BIO/18	*Genetic engineering*	6	48	Frontal lessons	B	In-presence	Biological disciplines	Mandatory
	BIO/10	*Microalgal resources*	6	52	Frontal lessons, exercises and laboratory	B	In-presence	Biological disciplines	Mandatory
Industrial and environmental biotechnology	BIO/11	Industrial Biotechnology	6	48	Frontal lessons	B	In-presence	Biological disciplines	Mandatory
	AGR/07	Biotechnology for the protection of the environment	6	48	Frontal lessons	C	In-presence		Mandatory
Transport Phenomena for Biotechnological Applications	ING-IND/24	Single	9	72	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
Biopolymers and Bioplastics	CHIM/11	*Polyester based bioplastics*	6	52	Frontal lessons, exercises and laboratory	B	In-presence	Chemical disciplines	Mandatory
	BIO/10	*Polysaccharide- and protein-based bioplastics*	6	52	Frontal lessons, exercises and laboratory	B	In-presence	Biological disciplines	Mandatory
Biorefinery processes	ING-IND/25	Single	6	48	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
Year II									

Title Teaching	SSD	Module	Credits	Hours	Type Activities	TAF	Course Modalities	Disciplinary area	Mandatory/ optional
Design of conversion processes	ING-IND/25	*Bioreactors*	6	48	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
	ING-IND/26	*Process simulation*	6	48	Frontal lessons	B	In-presence	Chemical disciplines	Mandatory
Hygiene principles in biotechnology	MED/42	Single	6	48	Frontal lessons	C	In-presence		Mandatory
Biochip and biosensors	FIS/01	Single	6	48	Frontal lessons	B	In-presence	Disciplines for professional skills	Mandatory
Environmental economics	SECS-P/02	Single	6	48	Frontal lessons	B	In-presence	Disciplines for professional skills	Mandatory
Independent choice of training activities student's			12(+)			D			Mandatory
Training and orientation to the world of work			18			F			
Final test			3			E			

(+) Every year the CCD offers courses available for independent student choice

ANNEX 2.1

COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Microbial and Industrial Biotechnologies	**Teaching Language:** Italian	
SSD (Subject Areas): CHIM/11		**CREDITS:** 6
Course year: I	**Type of Educational Activity:** B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: To provide the main concepts and methodologies necessary for the design of industrial processes that use microorganisms, cell cultures, and immobilized enzymes		
Learning objectives: Elements of yeast cell ultrastructure, growth methods and industrial media, metabolic characteristics. Enzymes and extremophile microorganisms of industrial interest. Production of metabolites of industrial interest. Immobilization of enzymes and microbial cells and their industrial applications. Microorganisms in industrial processes: the production of enzymes, antibiotics, and microbial biomass.		
Pre-requisites: none **Is a pre-requisite for:** none		
Types of examinations and other tests: Final oral exam		

ANNEX 2.1

COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Systems Biology and Bioinformatics	**Teaching Language:** Italian	
SSD (Subject Areas): BIO18 BIO10		**CREDITS:** 6 CFU 6 CFU
Course year: I	**Type of Educational Activity: Frontal Lessons**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Study of the expression of hereditary characters at the level of prokaryotic and eukaryotic cells, individuals, and populations. It investigates the genetic and molecular basis of complex biological processes such as development, evolution, immune response and the technologies derived from it. Biochemistry studies the structure, properties and functions of biomolecules, including proteins and nucleic acids, molecular structural biology, biocrystallography, biophysics, computational biochemistry and bioinformatics.		
Learning objectives: The students must acquire advanced knowledge of omics sciences such as genomic and transcriptomics as well as of the new generation technologies for the acquisition and analysis of omics data. Students must be able to understand specialist seminars on the topics covered by the course. The student will have to acquire knowledge of the IT tools necessary for consulting biological databases and for analyzing the sequences and three-dimensional structures of biological macromolecules (proteins and nucleic acids).		
Pre-requisites: none **Is a pre-requisite for:** **none**		
Types of examinations and other tests: Oral		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Industrial and environmental biotechnology	**Teaching Language:** Italian	
SSD (Subject Areas): BIO/11 AGR/07		**CREDITS:** 6 6
Course year: I	**Type of Educational Activity:** B C	

Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:

Study in the field of molecular biological functions of macromolecules. Study of the analysis of biochemical characteristics and interactions between nucleic acids and proteins, between proteins and proteins, and the relationships between the three-dimensional structure of proteins and nucleic acids and the biological functions they perform in all organisms.

Studies of the chemical, biochemical, genetic, biotechnological and ecological aspects of the soil-water-atmosphere plant system, in the agricultural environment, in forest, in the anthropogenic environment, with particular attention to the interactions that may be developed. Strategies and methodologies of genetic, molecular and biotechnological interventions aimed at promoting the enhancement and safeguarding of agrobiodiversity.

Learning objectives:

The educational objectives of the course are to introduce the theme of bioeconomy, circular economy and its applications; to provide students with the specialist knowledge for industrial processes involving the use of biomass and the processes related to biorefineries and the production of bio-based molecules; to teach the application of different molecules in different biotechnological fields, with particular attention to industrial applications; to provide students with knowledge in the field of the main biotic and abiotic factors of environmental pollution and phytoremediation techniques from inorganic and organic compounds; risk reduction resulting from the deliberate release into the environment of genetically modified plants and innovative assisted development techniques.

Pre-requisites:

None

Is a pre-requisite for:

None

Types of examinations and other tests:

Oral Exam

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Microalgal exploitation	**Teaching Language:** English	
SSD (Subject Areas): BIO/10 BIO/18		**CREDITS:** 6 6
Course year: I	**Type of Educational Activity:** B B	

Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:

Study of the properties of the chemical constituents of living matter, the structure and properties of simple and complex molecules of glucidic and lipidic nature, protein macromolecules and nucleic acids. Study of laboratory methodologies for qualitative and quantitative analysis and validation of experimental results. Studies in the field of transmission, modification and expression of hereditary characteristics at the level of prokaryotic and eukaryotic cells, using classical and molecular methodologies of genetics and microbiology and bioinformatics tools. Study and definition of the applications, at biotechnological and environmental level, of genetics, microbiology and molecular technologies derived from them.

Learning objectives:

The aim of the course is to present the world of microalgae and their applications. The course aims to provide students with the specialized notions for the cultivation of microalgae in different conditions. A systematic use of biomass will be studied in a biorefinery approach. A focus on the industrial techniques used for the extraction process will be provided to the students. In addition, the aim of the course is to apply different molecules in different biotechnological fields, with particular attention to industrial applications.

The information necessary to understand the main methods of genetic engineering of prokaryotic and eukaryotic organisms will be provided to allow the acquisition of in-depth knowledge of molecular and in silico methodologies that allow the study and development of modified or transgenic strains to optimise animal and plant species for biotechnological purposes.

Pre-requisites:

None

Is a pre-requisite for:

None

Types of examinations and other tests:

Oral Exam

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Transport Phenomena in Biological Systems	**Teaching Language:** Italian	
SSD (Subject Areas): ING-IND/24		**CREDITS:** 9
Course year: I	**Type of Educational Activity:** B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: The SSD focuses on the "Basic Process Design", i.e., the development of methodologies and technologies for the process industry (..., biotechnology, ...), based on physical, chemical and biological phenomena that characterize the specific transformations. The approach is based on a system perspective, using the tools ... of transport phenomena, so as to analyse the individual steps of each process and equipment, then recomposing them in a unified vision, ... Characteristic skills include transport phenomena (energy and mass transfer between phases, even in the presence of chemical reactions, ...); chemical and biochemical kinetics and reactors.		
Learning objectives: Provide the student with the knowledge necessary to deal with problems of mass transfer of biological interest.		
Pre-requisites: none **Is a pre-requisite for:** none		
Types of examinations and other tests: Written test and optional oral exam		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Biochemical Biotechnology	**Teaching Language:** Italian	
SSD (Subject Areas): BIO10 BIO10		**CREDITS:** 6 6
Course year: I	**Type of Educational Activity:** B B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Study and deepening of laboratory methodologies for the qualitative and quantitative analysis and the characterization of endogenous and exogenous protein macromolecules, for the observation of their modifications and for the validation of experimental results.		
Learning objectives: The student will acquire the theoretical-methodological knowledge necessary to design and conduct production of recombinant proteins in different hosts, for the construction and production of engineered recombinant proteins endowed with novel functions of biotechnological interest, as well as on the basic principles of metabolic engineering in the context of modern biotechnology.		
Pre-requisites: none **Is a pre-requisite for:** none		
Types of examinations and other tests: Oral		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Bioreactors	**Teaching Language:** Italian	
SSD (Subject Areas): ING-IND/25		**CREDITS:** 6
Course year: I	**Type of Educational Activity:** B	

Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:

The SSD includes the study of methodologies for the design of industrial plants based on chemical-physical transformations of matter aimed at the production of goods, the provision of services and the prevention or mitigation of habitat modifications induced by anthropic activities or settlements. Plant design includes the flowsheet of the process, the selection of the equipment for the progress of the process, the assessment of the design features, the processing of functional diagrams including the protection and control instrumentation, the analysis of risk and environmental protection, the evaluation of costs. For the SSD, the key issues are: the functional design and selection of reactors and equipment for unitary operations and for specific exchange and separation applications; the global vision of the plant and the ability to recompose the different aspects in a project and in a functional scheme; the safety and environmental impact of the plants.

Learning objectives:

The activity is aimed to provide the student the tools to: (i) demonstrate knowledge and ability to understand the problems relating to the correlation among: enzymatic or microbial kinetics (unstructured and non-segregated); type of reactor (batch, fed-batch, CSTR, PFR with and without recycling) used; confined or free biocatalysts; process productivity; mass transport between heterogeneous phases; (ii) demonstrate the ability to extend the analyzed systems with reference to structured microbial kinetics; (iii) demonstrate the ability to design bioconversion units on the basis of enzymatic/microbial kinetics and productivity assigned to the type of mixing/segregation present in the reactor; (iv) be able to select the operating conditions of the reactor to also satisfy heterogeneous reactive processes associated with transport of matter between phases; (v) demonstrate the ability to make an approximate economic estimate of a biotechnological process.

Pre-requisites:

None

Is a pre-requisite for:

None

Types of examinations and other tests:

Written

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MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Transport Phenomena for Biotechnological Applications	**Teaching Language:** English	
SSD (Subject Areas): ING-IND/24		**CREDITS:** 9
Course year: I	**Type of Educational Activity:** lectures	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Transport phenomena with applications to process engineering		
Learning objectives: Providing the student with the necessary knowledge to deal with problems related to transport phenomena in biotechnological processes.		
Pre-requisites: None **Is a pre-requisite for:** None		
Types of examinations and other tests: written and oral		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Biopolymers and bioplastics	**Teaching Language:** English	
SSD (Subject Areas): CHIM/11 BIO/10		**CREDITS:** 6 6
Course year: I	**Type of Educational Activity:** B B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Designing of industrial processes exploiting microbes and/or enzymes, engineered or not, for the production of bio-based biopolymers and their application in pharmaceutical, food and chemical sector. Characterization of biopolymers (polysaccharides and proteins) for their use in the industrial sector through the study of laboratory methodologies.		
Learning objectives: The course aims at providing students with advanced notions related to the design, synthesis and application of natural polymers and bioplastics form renewable sources.		
Pre-requisites: None **Is a pre-requisite for:** None		
Types of examinations and other tests: Oral Exam		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Biorefinery Processes	**Teaching Language:** English	
SSD (Subject Areas): ING-IND/25		**CREDITS:** 6
Course year: I	**Type of Educational Activity:** B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Design and selection of equipment for unit operations and for specific exchange and separation applications in the biotechnology industry: liquid-liquid extraction, ultrafiltration, adsorption, precipitation/crystallization. Thermodynamic equilibrium. Different types of chromatographic operations. Economic analysis of biotechnological processes: objective functions, plant costs and operating costs, economic optimization criteria.		
Learning objectives: The student must be able to select unit operations to exploit renewable resources and to design selected units.		
Pre-requisites: None **Is a pre-requisite for:** None		
Types of examinations and other tests: Written exam with numerical exercises.		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: PRINCIPLES OF HYGIENE IN BIOTECHNOLOGY	**Teaching Language:** Italian	
SSD (Subject Areas): MED/42		**CREDITS:** 6
Course year: II	**Type of Educational Activity:** C	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Definition of health. Factors influencing the illness state. General background about epidemiology. Definition and case studies in epidemiology. Methods in epidemiology. Data sources. Measures in epidemiology. Descriptive epidemiology. Analytical epidemiology: retrospective, transversal and prospective investigations. Experimental epidemiology. Epidemiology and disease prevention. Factors depending on the physical environments: air, water, soil and climate. Factors depending on the biological environment: microorganisms and food. Risk management (HACCP). Factors depending on the biotechnological manipulation: vaccine, wastewater and food. Factors depending on the social context: urbanization, building and indoor conditions. Factors depending on personal actions: eating habits. Background about prevention and biotechnologies in public health.		
Learning objectives: The student must be able to apply the acquired knowledge to evaluate and quantify hygienic problems related to the biotechnology field and the risk factors related to human health. The training course is aimed at transmitting the operational skills necessary to concretely apply the knowledge with reference to hygiene in biotechnologies		
Pre-requisites: None **Is a pre-requisite for:** None		
Types of examinations and other tests: Written, oral test or a combination of them		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Biotechnological processes	**Teaching Language:** Italian
SSD (Subject Areas): ING-IND/25 ING-IND/26	**CREDITS:** 6 6
Course year: II	**Type of Educational Activity:** B B
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Functional design and choice of equipment for unit operations and for specific exchange and separation applications; safety and environmental impact of plants. The reference fields are those relating to chemical, biochemical, pharmaceutical, food, energy technologies as well as environmental protection. Development and application of mathematical models for the analysis, modelling, identification and simulation of systems of process industry; statistical methods for the process industry; methods for statistical analysis of data and definition of experiments for lab, pilot, and industrial scale.	
Learning objectives: (i) Provide the basics of plant design for bioseparation processes and introduce to the problems of designing bioprocesses on an industrial scale, with a specific interest to the single unit operations involved in the recovery and purification phase of the biomolecules of interest. (ii) Correctly identify the simplifying assumptions and the mathematical model of a process, and the most appropriate numerical technique to solve it through a numerical software. (iii) Estimate the parameters of mathematical models of interest in industrial biotechnology through regression statistical techniques.	
Pre-requisites: None **Is a pre-requisite for:** None	
Types of examinations and other tests: Written exam	

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Biosensors and biochip	**Teaching Language:** Italian	
SSD (Subject Areas): FIS/07		**CREDITS:** 6
Course year: II	**Type of Educational Activity:** B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Application of innovative physical methods and techniques necessary for the study and conservation of cultural heritage. It also includes the skills suitable for the study and development of physical methodologies (theoretical and experimental) necessary both for the description and understanding of living matter in the environmental, biological and medical context, and for the development and use of the instrumentation necessary for the control and detection of physical phenomena in the field of prevention, diagnosis and treatment. The skills of this sector also concern research in the field of biophysics and physical techniques of biomedical diagnostics, as well as in the field of radiation protection of man, the environment and things.		
Learning objectives: The course aims to introduce students to micro and nanotechnologies with relevant applications in the field of biosensors. In particular, students will be provided with the necessary knowledge for the development and implementation of different types of biosensors useful for the recognition of any analyte in the environmental, industrial and medical fields. Furthermore, the procedures for the scale-up of the various biosensors in the industrial field will be shown in the course.		
Pre-requisites: none **Is a pre-requisite for:** none		
Types of examinations and other tests: Oral exam and practical test		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Environmental Economics	**Teaching Language:** English	
SSD (Subject Areas): SECS/P02		**CREDITS:** 6
Course year: II	**Type of Educational Activity:** B	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Review of the Economic Approach to environmental issues. Market Allocation, Market Failures Property rights, Externalities. Economic Foundations of Cost Benefit Analysis. Dynamic Efficiency and Sustainable Development. Non Renewable and Renewable Resources. Energy transition in Market Economies.		
Learning objectives: At the end of the course and after due study students endowed with an adequate background are expected to understand the basic structure of microeconomics, behavioral hypothesis about economic agents (consumers and firms) and their coordination through markets, the typical situation where market failures is expected to occur and the role of public intervention in this case. These notions will allow students to understand causal chains and main relationships between public intervention and market allocation, with a specific focus in cost benefit analysis, dynamic allocations of non renewable resources and energy transition.		
Pre-requisites: None **Is a pre-requisite for:** None		
Types of examinations and other tests: Written essays and oral interview on the topics		

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COURSE REGULATIONS

MASTER DEGREE IN INDUSTRIAL AND MOLECULAR BIOTECHNOLOGY

CLASS LM-8

School: Polytechnic School and Basic Sciences

Department: Chemical Sciences

Regulations in force for the academic year 2023-2024

Course: Internship and Guidance to the World of Work	**Teaching Language:** Italian	
SSD (Subject Areas): internship		**CREDITS:** 18
Course year: II	**Type of Educational Activity:** F	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course: Internship at the laboratories of research groups on specific training projects. Through meetings with representatives of companies in the sector, it is intended to bring students closer to the world of work.		
Learning objectives: To provide students with a clear vision of future prospects, both in the field of work and in the continuation of their studies. Learning of analytical methodologies and instrumental techniques with attention to specific research projects.		
Pre-requisites: none **Is a pre-requisite for:** none		
Types of examinations and other tests: Frequency		