DIDACTIC REGULATIONS FOR THE DEGREE COURSE SCIENCES AND TECHNOLOGIES OF INDUSTRIAL CHEMISTRY

CLASS LM-71

School: Polytechnic School and of Basic Sciences

Department: Department of Chemical Science

Regulations in force from 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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IMPORTANT: When filling in the Rules and Regulations, it is necessary to remember that articles referring to areas in the SUA must contain the exact wording as already present in the SUA. If you wish to change part of the text, you must remember that this action involves a change of the Rules or, if the field to be changed is RAD, of the Order.

Art. 1
Object

1. These Regulations govern the organizational aspects of the Study Course in Science and Technology of Industrial Chemistry (class LM-71). The Study Course in Science and Technology of Industrial Chemistry belongs to the Department of Chemical Sciences.

Source: SUA-CdS

Framework: General Course Information

Course name in Italian and English

Scienze e Tecnologie della Chimica Industriale
Sciences and Tecnologies of Industrial Chemistry

Class

LM71

Teaching language

Italian- Part of the corses are given in English

2. The CdS is governed by the Didactic Coordination Commission (CCD), pursuant to Art. 4 of the RDA.

Source: SUA-CdS

Framework: Contact Person and Structure

Collegiate Management Body of the Degree Course

Didactic Coordination Commission of the CdLM of Industrial Chemical Sciences and Technologies

3. 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

Source: SUA

Framework: A4.a – RAD

The Master's Degree Course in Sciences and Technologies of Industrial Chemistry of the class of the same name LM-71 has the following specific educational objectives:

(I) To deepen the knowledge of chemistry in the various disciplinary sectors of Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and Physical Chemistry with particular attention, for each discipline, to those aspects that may be useful for the development of the topics of applicative interest which constitute the main part of the degree course. In this regard, the chemistry insights will cover both theoretical and experimental aspects;

(II) To provide a solid knowledge of Industrial Chemistry and Chemical Plants which allows the student to know the main products and materials of the chemical industry and the processes for obtaining them. This starts from an operational research phase, at the laboratory level, to move on to the implementation and management of pilot plants, up

to the understanding of the structure and operation of industrial plants. In other words, students will be prepared to operate, respecting ethical constraints, especially in the field of research and development of industrial chemistry, acquiring the necessary tools for the development, on an industrial level, of products, materials and processes, always remaining within the limits of sustainable chemistry;

(III) The Degree Course includes several curricula corresponding to professional specializations in rather vast sectors of Industrial Chemistry such as: (a) Polymer Science, (b) Products, Processes and Environmental Protection, (c) Industrial Formulations. A number of curricular courses plus a rich offer of elective courses in the sectors covered by the curricula will allow the student to achieve in-depth professionalism to be asserted on the job market.

(IV) The internship and the degree thesis will complete the cultural education of the students by engaging them in intense activities: laboratory, processing of the results obtained, collection, processing and synthesis of literature information and presentation of the work done with language properties and scientific rigor. The training activities, lessons and laboratory exercises, dedicated in particular to the knowledge of experimental methods and data processing, foresee, in relation to specific objectives, external activities such as training internships in companies, public administration structures and laboratories, as well as study at other Italian or foreign universities, also within the framework of international agreements;

(V) An indirect educational objective is the achievement by the student of the independence of judgment and work by adopting the scientific methods of investigation and study that will be repeated during the entire course of study. The specific training objectives and the expected learning outcomes in terms of knowledge, skills and behaviors will be assessed by referring to the European descriptor system such as the Dublin descriptors.

Art. 3
Professional profile and work opportunities

Source: SUA
Framework: A2.a - RAD

Function in a working context:
Graduates in Science and Technology of Industrial Chemistry will be able to autonomously carry out functions of responsibility both in the production and research sectors. They may hold the position of Manager of:

-Chemical Analysis Laboratory;
-Property Analysis Laboratory of Materials;
-Synthesis laboratory;
- Quality Control Management;
-Management of Chemical Plants.

They may also hold the position of technical/commercial manager in the marketing of products or chemical plants.

Skills associated with the function:

Graduates in Industrial Chemistry Sciences and Technologies possess a solid theoretical and experimental background which allows them to master the scientific method of investigation with special reference to product-process connections, molecular structure - properties of materials, scale transitions and to sustainable development. They have a high scientific and technological preparation that can be used in the industrial chemistry sector and in other productive sectors. In particular, they have adequate knowledge and skills to assume project and facility responsibilities in the manufacture, handling, application and control of chemicals and materials.

Employment opportunities:
Graduates in Science and Technology of Industrial Chemistry can find employment:

- in chemical/pharmaceutical/food industries
- at waste treatment plants
- in industry in general.
- at private chemical laboratories
- at the offices of the public administration
- at research institutes

Art. 4
Admission requirements and knowledge required for access to the Degree Course[1]

Source: SUA
Framework: A3.a - RAD

One can be admitted to the CdS in Science and Technology of Industrial Chemistry having a Degree in Class L27 in the curriculum of which there are a minimum of 6 ECTS of the CHIM/04 sector and 6 ECTS of the ING-IND/25 sector. Further access requirements are the achievement of at least 4 credits in the English language or a certification of a competence of at least level B1. Within the CdS, a further 4 credits of knowledge of the English language are foreseen to ensure the B2 level competence of the graduates.

Art. 5
Procedures for access to the Degree Course

Verification of personal preparation is mandatory in any case, and can only be accessed by students who meet the curricular requirements.

Source: SUA
Framework: A3.b

In the event that the study curriculum does not meet the above requirements, the Commission for Student Practices will evaluate the level of preparation of the student on a preliminary basis and will suggest any curricular additions to be acquired in order to obtain admission and the methods for doing so through a personalized study plan (Personal study plan) or the acquisition of credits through single courses. The Commission will admit the student only after careful verification that the admission requirements have actually been met. For all students with an exam average of less than or equal to 23.00, preparation will also be assessed using methods that will be decided by the student practices commission.

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

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;
- 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

The didactic activity is carried out in mode "a. Conventional Degree Course"[5]
If necessary, the CCD decides which subjects 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 conducted can be found on the course sheets.

[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)"]

[5] Please note that, according to Ministerial Decree 289 of 25 March 2021 (general guidelines for the three-year planning of universities 2021-2023), in Annex 4, letter A, the types of courses are as follows:

a) Conventional Degree Courses. Degree Courses delivered entirely in person, or which provide - for activities other than practical and laboratory activities - a limited teaching activity delivered electronically, to an extent not exceeding one tenth of the total.

b) Degree Courses with mixed modality. Degree Courses that provide - for activities other than practical and laboratory activities - a significant proportion of the educational activities delivered electronically, but no more than two-thirds.

c) Degree Courses mainly delivered by distance learning. Degree Courses delivered predominantly by telematic means, to an extent exceeding two-thirds (but not all) of the training activities.

d) Degree Courses delivered entirely at a distance. In these courses all the training activities are delivered electronically; the presence of the examinations of profit and discussion of the final examinations remains unaffected.

Art. 8
Testing of learning activities[6]

1. The Didactic Coordination Commission, within the regulatory limits laid down[7], 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[8] , attributable to the following Types of Educational Activities (TAF):

   B) characterising,
   C) related or complementary,
   D) at the student's choice[9] ,
   E) for the final exam,
   F) further training activities.

2. The degree is awarded after having acquired 70 ECTs [see note 9] by passing examinations, not exceeding 12[10] , and the performance of the other educational activities.

[6] Article 20 of the University Didactic Regulations.
[7] 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).
[8] 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.
[9] 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).
[10] Art. 11, c. 7 of the University Didactic Regulations ('the final exam for the master's degree is included in the calculation of the maximum number of exams').

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[11]) 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[12]).
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[13]

1. In general, attendance of lectures is compulsory
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.

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 the UniNA teaching website.

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

[12] 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".

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

Art. 12
Course Calendar

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

Art. 13
Guidelines for the recognition of credits earned in other Courses in the same Class[14]

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[15]; 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[16].
3. With regard to the criteria for the recognition of ECTs acquired in extra-curricular activities, within the limit of 12 CFU the following activities may be recognised:
   - 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

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

Guidelines for enrolment in individual Degree Courses

Enrolment in individual teaching courses, provided for by the University Didactic Regulations[17], is governed by the "University Regulations for enrolment in individual teaching courses activated as part of the Degree Courses "[18].

Article 16
Features and arrangements for the final examination

Source: SUA

Framework: A5a (RAD) and A5b

The final exam for the achievement of the Master's Degree in Industrial Chemical Sciences and Technologies will consist in the presentation of a written text relating to the results achieved in an original research work elaborated under the guidance of a supervisor and in the public discussion of the thesis by the Candidate in the presence of the Graduation Commission made up of 7 members appointed by the board of the Department of Chemical Sciences.

After the internship, students who have followed the safety course can ask the members of the research groups pertaining to the degree course to assign a topic for their degree thesis. The thesis can also be carried out in research groups or structures whose members are external to the Degree Course, subject to the approval of the Degree Thesis Assignment Commission and the designation of a Supervisor who is part of the structure to be supported by a co-supervisor of the external structure.
The thesis project will be formally approved, after the pre-graduate seminar, by the Degree Thesis Assignment Commission, having consulted the Academic Board. During this Seminar, the Student will publicly describe the essential lines of his research work. At the same time, the Commission will assign two co-supervisors who will follow the thesis work through periodic interviews. The pre-graduate Seminar can be held by the Student only 1 month after the end of the Internship. At least 6 months must pass from the date of the pre-graduate seminar before the discussion of the thesis.
The Candidate's work will be judged by a Graduation Commission made up of 7 members appointed by the Council of the Department of Chemical Sciences. The degree mark, expressed out of one hundred and ten, will be established on the basis of the weighted average of the scores achieved by the student in the exams taken (expressed out of one hundred and ten), and on the basis of the result of the Final Exam.
A maximum of 11/110 points are attributed to the Final Examination, taking into account the characteristics of the final report, the presentation and the time taken to obtain the Degree. If the overall evaluation exceeds 110/110 points, the Commission can proceed with the attribution of honors.

Article 17
Guidelines for work internships and placements

1. Students enrolled in the degree course may decide to carry out internships or training periods with organisations or companies that have an agreement with the University. Internships and placements are not compulsory, and contribute to the award of credits for the other educational

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

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[19].

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 Exit Orientation and Placement Commission of the Polytechnic School and of Basic Sciences which includes representatives of the Department of Chemical Sciences, 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[20]

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[21].
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 SINAPSI University Center (www.sinapsi.unina.it), 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)[22] system, developed in accordance with the document "Self-evaluation, Evaluation and Accreditation of the Italian University System" of ANVUR, using:

[19] Letter d traineeships can be both internal and external; letter d traineeships and placement can only be external.
[20] Art. 21 of the University Didactic Regulations.
[21] R.D No. 2482//2020.
[22] 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

SCIENCES AND TECHNOLOGIES OF INDUSTRIAL CHEMISTRY

CLASS LM-71

School: Polytechnic School and of Basic Sciences

Department: Chemical Science

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									
Year I									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities**	**Course Modalities**	**TAF**	**Disciplinary area**	**Mandatory / optional**
Complements of Inorganic Chemistry	**Chim/03**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Organic Analysis and Synthesis	**Chim/06**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Chemical plants	**Ing-Ind/25**	**Single**	**8**	**64**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Industrial Chemistry I	**Chim/04**	**Industrial Chemistry I**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Exercises and laboratory of Industrial chemistry	**5**	**52**	**Laboratory**	**In-person**			
Industrial Chemistry II	**Chim/04**	**Industrial Chemistry II**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Industrial Chemistry Laboratory II	**5**	**52**	**Laboratory**	**In-person**			

Industrial physical chemistry	**Chim/02-Chim/04**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**C**	**2.2**	**Mandatory**
Curricular course I	**Chim/02-Chim/04**	**Single**	**6**	**48/64**	**Frontal lesson**	**In person**	**B/C**	**2.2**	**Mandatory**
Additional language skills (English)		**Single**	**4**	**32**			**F**		**Mandatory**

Year II									
Curriculum: All curricula									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities** *(lectures, workshops, etc.)*	**Course Modalities** *(in- person, remote)*	**TAF**	**Disciplinary area**	**Mandatory/ optional**
Curricular course II	**Chim/04-Ing-Ind/25**	**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Curricular course III	**Chim/04-Chim/01-Chim/02-Chim/03-Chim/06**	**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**B/C**	**2.2**	**Mandatory**
Elective course		**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**D**		**Optional**
Further knowledge Internship			**4**	**100**			**F**		**Mandatory**
Elective course		**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**D**		**Optional**
Curricular course IV	**Chim/03-Chim/04-Ing-Ind/25-Ing-Ind/24**	**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**B/C**	**2.2**	**Mandatory**
Activities for the preparation of the master degree thesis			**29**	**725**			**E**		**Mandatory**
Final test			**1**				**E**		**Mandatory**

List of prerequisites

There are no prerequisites

ANNEX 1.2

COURSE REGULATIONS

SCIENCES AND TECHNOLOGIES OF INDUSTRIAL CHEMISTRY

CLASS LM-71

School: Polytechnic School and of Basic Sciences

Department: Chemical Science

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 Polymer Science									
Year I									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities**	**Course Modalities**	**TAF**	**Disciplinary area**	**Mandatory / optional**
Complements of Inorganic Chemistry	**Chim/03**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Organic Analysis and Synthesis	**Chim/06**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Chemical plants	**Ing-Ind/25**	**Single**	**8**	**64**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Industrial Chemistry I	**Chim/04**	**Industrial Chemistry I**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Exercises and laboratory of Industrial chemistry	**5**	**52**	**Laboratory**	**In-person**			
Industrial Chemistry II	**Chim/04**	**Industrial Chemistry II**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Industrial Chemistry Laboratory II	**5**	**52**	**Laboratory**	**In-person**			

Industrial physical chemistry	**Chim/02**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**C**	**2.2**	**Mandatory**
Polymer Chemistry and Technology	**Chim/04**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**B**	**2.2**	**Mandatory**
Additional language skills (English)		**Single**	**4**	**32**			**F**		**Mandatory**

Year II									
Curriculum: All curricula									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities** *(lectures, workshops, etc.)*	**Course Modalities** *(in- person, remote)*	**TAF**	**Disciplinary area**	**Mandatory/ optional**
Properties and Structure of Polymers	**Chim/04**	**single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Characterization Methods of Polymeric Materials	**Chim/04**	**single**	**6**	**56**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Elective course		**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**D**		**Optional**
Further knowledge Internship			**4**	**100**			**F**		**Mandatory**
Elective course		**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**D**		**Optional**
Chemical Technologies for the Circular Economy of Polymers	**Chim/04**	**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**C**	**2.2**	**Mandatory**
Activities for the preparation of the master degree thesis			**29**	**725**			**E**		**Mandatory**
Final test			**1**				**E**		**Mandatory**

List of prerequisites

There are no prerequisites

ANNEX 1.2

COURSE REGULATIONS

SCIENCES AND TECHNOLOGIES OF INDUSTRIAL CHEMISTRY

CLASS LM-71

School: Polytechnic School and of Basic Sciences

Department: Chemical Science

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 Products processes and environmental protection									
Year I									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities**	**Course Modalities**	**TAF**	**Disciplinary area**	**Mandatory / optional**
Complements of Inorganic Chemistry	**Chim/03**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Organic Analysis and Synthesis	**Chim/06**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Chemical plants	**Ing-Ind/25**	**Single**	**8**	**64**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Industrial Chemistry I	**Chim/04**	**Industrial Chemistry I**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Exercises and laboratory of Industrial chemistry	**5**	**52**	**Laboratory**	**In-person**			
Industrial Chemistry II	**Chim/04**	**Industrial Chemistry II**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Industrial Chemistry Laboratory II	**5**	**52**	**Laboratory**	**In-person**			

Industrial physical chemistry	**Chim/02**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**C**	**2.2**	**Mandatory**
Development and control of industrial chemical processes	**Chim/04**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**B**	**2.2**	**Mandatory**
Additional language skills (English)		**Single**	**4**	**32**			**F**		**Mandatory**

Year II									
Curriculum: All curricula									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities** *(lectures, workshops, etc.)*	**Course Modalities** *(in- person, remote)*	**TAF**	**Disciplinary area**	**Mandatory/ optional**
Wastewater treatment processes and plants	**Ing-Ind/25**	**single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Analytical methods for quality and process control	**Chim/01**	**single**	**6**	**48**	**Frontal lesson**	**In-person**	**C**	**2.2**	**Mandatory**
Elective course		**single**	**6**	**48**	**Frontal lesson**	**In-person**	**D**		**Optional**
Further knowledge Internship			**4**	**100**			**F**		**Mandatory**
Elective course		**single**	**6**	**48**	**Frontal lesson**	**In-person**	**D**		**Optional**
Safety in industrial chemical processes	**Chim/04**	**single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Activities for the preparation of the master degree thesis			**29**	**725**			**E**		**Mandatory**
Final test			**1**				**E**		**Mandatory**

List of prerequisites

There are no prerequisites.

ANNEX 1.2

COURSE REGULATIONS

SCIENCES AND TECHNOLOGIES OF INDUSTRIAL CHEMISTRY

CLASS LM-71

School: Polytechnic School and of Basic Sciences

Department: Chemical Science

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 Industrial Formulations									
Year I									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities**	**Course Modalities**	**TAF**	**Disciplinary area**	**Mandatory / optional**
Complements of Inorganic Chemistry	**Chim/03**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Organic Analysis and Synthesis	**Chim/06**	**Single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.1**	**Mandatory**
Chemical plants	**Ing-Ind/25**	**Single**	**8**	**64**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Industrial Chemistry I	**Chim/04**	**Industrial Chemistry I**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Exercises and laboratory of Industrial chemistry	**5**	**52**	**Laboratory**	**In-person**			
Industrial Chemistry II	**Chim/04**	**Industrial Chemistry II**	**5**	**40**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
		Industrial Chemistry Laboratory II	**5**	**52**	**Laboratory**	**In-person**			

Industrial physical chemistry	**Chim/02**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**C**	**2.2**	**Mandatory**
Physical chemistry of formulations	**Chim/02**	**Single**	**6**	**48**	**Frontal lesson**	**In person**	**B**	**2.2**	**Mandatory**
Additional language skills (English)		**Single**	**4**	**32**			**F**		**Mandatory**

Year II									
Curriculum: All curricula									
Title Teaching	**SSD**	**Module**	**CREDITS**	**Hours**	**Type Activities** ***(lectures, workshops, etc.)***	**Course Modalities** ***(in- person, remote)***	**TAF**	**Disciplinary area**	**Mandatory/ optional**
Formulation Industry	**Chim/04**	**single**	**6**	**48**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Polymer Formulations	**Chim/04**	**single**	**6**	**56**	**Frontal lesson**	**In-person**	**B**	**2.2**	**Mandatory**
Elective course		**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**D**		**Optional**
Further knowledge Internship			**4**	**100**			**F**		**Mandatory**
Elective course		**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**D**		**Optional**
Rheology	**Ing-Ind/24**	**single**	**6**	**48/64**	**Frontal lesson**	**In-person**	**C**	**2.2**	**Mandatory**
Activities for the preparation of the master degree thesis			**29**	**725**			**E**		**Mandatory**
Final test			**1**				**E**		**Mandatory**

List of prerequisites

There are no prerequisites

ANNEX 2.1

COURSE REGULATIONS

SCIENCES AND TECHNOLOGY OF INDUSTRIAL CHEMISTRY

CLASS LM-71

School: Polytechnic School and of Basic Sciences

Department: Chemical Science

Regulations in force for the academic year 2023-2024

Characterizing Courses (TAF B)

Course: Complements of Inorganic Chemistry	Teaching Language: English
SSD (Subject Areas): CHIM/03	CREDITS: 6
Course year: I	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The course intends to critically illustrate the aspects of Inorganic Chemistry relevant to the chemistry of materials and industrial catalysis in the field of "fine chemistry". In particular, the chemical bond, structure and reactivity of organometallic and coordination compounds (with examples of applications in catalytic processes of industrial interest), characterization (NMR, IR), and molecular symmetry will be covered.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Written and oral test	

Course: Organic Analysis and Synthesis	Teaching Language: English
SSD (Subject Areas): CHIM/06	CREDITS: 6
Course year: I	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The course introduces students to the recognition of an organic substance through spectroscopic and spectrometric methods. At the same time, the course offers students an overview of the main transformation reactions of functional groups of organic molecules useful at an industrial level. The student will have to master the reading of both NMR spectra (one- and two-dimensional) and EI, ESI and MALDI mass spectrometry. The student will also have to acquire critical skills in the formulation of structural hypotheses. Finally, the student will have to become more familiar with the main transformations of functional groups in organic chemistry.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Written and oral test	

Course: **Chemical Plants**	**Teaching Language:** **Italian**	
SSD (Subject Areas): **ING-IND/25**		**CREDITS:** **8**
Course year: I	**Type of Educational Activity: B**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The student must demonstrate knowledge, ability to understand and to process even complex discussions concerning problems relating to chemical reactor systems, non-isothermal operations, non-ideal flow conditions and heterogeneous processes. This will be achieved starting from the notions learned here and through the training course of the Teaching which intends to provide the Learner with the appropriate knowledge and methodological tools, also through numerical exercise activities. The student must demonstrate the ability to solve conceptual and design problems related to ideal and non-ideal chemical reactors, even in combination and in the presence of multiple and/or non-isothermal and/or heterogeneous chemical reactions**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Written and oral test**		

Course: Industrial Chemistry I **Module: Industrial Chemistry I**	**Teaching Language:** **Italian**	
SSD (Subject Areas): **CHIM/04**		**CREDITS:** **5**
Course year: I	**Type of Educational Activity: B**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The educational path of the course intends to provide students with in-depth knowledge and advanced methodological tools to analyze the fundamental aspects of industrial chemical processes and the problems connected to them of a scientific and technological nature.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Final oral exam and evaluation of assigned group work.**		

Course: Industrial Chemistry I **Module: Exercises and Laboratory of Industrial Chemistry I**	**Teaching Language:** **Italian**	
CHIM/04		**CREDITS:** **5**
Course year: I	**Type of Educational Activity: B**	
Teaching Methods: **In-person + Laboratory**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The training course is oriented towards transmitting the ability to propose solutions to problems encountered in the management and/or design of a chemical process, on the basis of illustrated examples and numerical and laboratory exercises.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Final written and/or oral test and evaluation of the reports relating to the laboratory exercises.**		

Course: Industrial Chemistry II **Module: Industrial Chemistry II**	**Teaching Language:** **Italian**
SSD (Subject Areas): **CHIM/04**	**CREDITS:** **5**
Course year: I	**Type of Educational Activity: B**
Teaching Methods: **In-person**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: **Acquisition of the fundamental notions on the crystalline molecular structure and on the physical and mechanical properties of metallic, ceramic and polymeric inorganic materials. The objective is to provide the concepts underlying the molecular approach in the study of the physical and mechanical properties of materials which allows to interpret and correlate the properties of use of a material to its molecular and crystalline structure.**	
Pre-requisites: None **Is a pre-requisite for: None**	
Types of examinations and other tests: **Oral exam.**	

Course: Industrial Chemistry II **Module: Industrial Chemistry Laboratory II**	**Teaching Language:** **Italian**
SSD (Subject Areas): **CHIM/04**	**CREDITS:** **5**
Course year: I	**Type of Educational Activity: B**
Teaching Methods: **In-person**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: **Acquisition with laboratory exercises of the main experimental techniques for the characterization of metallic, ceramic and polymeric materials. Numerical exercises and data analysis for the study of the relationships between properties measured in the laboratory and molecular and crystalline structure.**	
Pre-requisites: None **Is a pre-requisite for: None**	
Types of examinations and other tests: **Oral test and evaluation of the reports relating to the laboratory exercises.**	

Course: Industrial Physical Chemistry	**Teaching Language: Italian**	
SSD (Subject Areas): **CHIM/02**		**CREDITS:** **6**
Course year: I	**Type of Educational Activity: C**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The course aims to develop students' ability to analyze the behavior of real, closed and/or open, systems in terms of their thermodynamic properties. The course includes a large number of numerical exercises, many of which concern common problems of industrial chemistry, which allow students to verify the skills acquired by studying the exposed theoretical topics.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Written and oral test.**		

Educational Curriculum: Products, Processes and Environmental Protection

Course: Development and Control of Industrial Chemical Processes.	**Teaching Language: Italian**	
SSD (Subject Areas): CHIM/04		**CREDITS: 6**
Course year: I	**Type of Educational Activity: B**	
Teaching Methods: In-person		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: The student must demonstrate the ability to approach the simulation of chemical reactors, deriving the mass and energy balance equations of reactors. The course allows students to acquire the knowledge and tools to be able to simulate the operation of separation units and to acquire analogic signals from laboratory equipment.		
Pre-requisites: None Is a pre-requisite for: None		
Types of examinations and other tests: Oral exam.		

Course: Wastewater Treatment Processes and Plants	**Teaching Language: Italian**	
SSD (Subject Areas): ING-IND/25		**CREDITS: 6**
Course year: II	**Type of Educational Activity: B**	
Teaching Methods: In-person		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: The student must demonstrate knowledge, ability to understand and to elaborate even complex discussions concerning the problems relating to the dedusting of gaseous streams and the removal of gaseous pollutants. This will be achieved starting from the notions learned here and through the training course of the Teaching which intends to provide the Learner with the appropriate knowledge and methodological tools. The student must demonstrate the ability to solve conceptual and design problems related to gaseous waste treatment processes for the removal of solid and gaseous pollutants.		
Pre-requisites: None Is a pre-requisite for: None		
Types of examinations and other tests: Oral exam.		

Course: Safety in Industrial Chemistry Processes	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The aim of the course is to provide an overview of the issues related to safety in industrial plants and to the analysis and assessment of plant risks.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral exam.	

Course: Analytical Methods for Quality and Process Control	Teaching Language: Italian
SSD (Subject Areas): CHIM/01	CREDITS: 6
Course year: II	Type of Educational Activity: C
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The student must demonstrate knowledge and ability to understand the problems relating to the methods of analysis of the species present in chemical processes. The educational path of the course intends to provide students with the knowledge and advanced methodological tools necessary for the development and validation of an analytical method for the characterization of analytes and/or pollutants present in different matrices. The student must demonstrate that he is able to define an analytical process to solve problems concerning the characterization at the molecular level of an industrial matrix and/or to extend the methodologies learned also to areas other than the industrial one. The training course is aimed at transmitting the operational skills necessary to concretely apply the knowledge and foster the ability to make full use of the methodological tools provided during the course.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral exam.	

Teaching Curriculum: Polymer Science

Course: Chemistry and Technology of Polymers	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: In this course the main polymers of industrial interest and new classes of "high added value" polymeric materials will be examined, illustrating the production technologies, chemical and physical properties, transformation technologies and applications for each of them. Composite materials and the environmental problems associated with the production, recycling and waste disposal of polymeric materials will also be briefly discussed. For each class of polymers, information is provided on the production processes, on the synthetic methods used and on the economic aspects (costs and quantities produced).	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral and/or written exam.	

Course: Properties and Structure of Polymers	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The aim is to provide students with the theoretical and methodological tools for studying the relationships between properties and structure of polymeric materials in the condensed phase (mainly for semi-crystalline systems) by examining both the influence of the structure of the polymer chains (constitution and configuration) and that of the morphology resulting from the thermo-mechanical history to which the material is subjected.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral and/or written exam.	

Course: Methods of Characterization of Polymeric Materials.	**Teaching Language: Italian**	
SSD (Subject Areas): CHIM/04		**CREDITS: 6**
Course year: II	**Type of Educational Activity: B**	
Teaching Methods: In-person		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: Acquisition of the main methods for the characterization of the structure and chemical-physical properties of polymers.		
Pre-requisites: None Is a pre-requisite for: None		
Types of examinations and other tests: Discussion of laboratory reports. Power point presentation (also for groups) relating to the exercises carried out (in Italian or English). Oral exam.		

Course: Chemical Technologies for the Circular Economy of Polymers.	**Teaching Language: Italian**	
SSD (Subject Areas): CHIM/04		**CREDITS: 6**
Course year: II	**Type of Educational Activity: C**	
Teaching Methods: In-person		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: The course describes the principles for the development of chemical synthesis and process technologies for the transition from the linear economy of polymers to the circular economy of polymers based on the design and synthesis of innovative biodegradable and renewable polymers and on recycling technologies of polymers and plastic waste, with particular reference to the chemical recycling of polymers to rescue the starting monomers.		
Pre-requisites: None Is a pre-requisite for: None		
Types of examinations and other tests: Oral exam.		

Educational Curriculum: Industrial Formulations

Course: Physical chemistry of formulations.	Teaching Language: Italian
SSD (Subject Areas): CHIM/02	CREDITS: 6
Course year: I	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The course aims to provide the student with skills in the design, preparation and thermodynamic, dynamic and spectroscopic characterization of colloidal formulations of industrial interest. Initially, the basic thermodynamic skills are summarized and deepened; the principles of thermodynamics of colloids and interfaces are then introduced. In the last part of the course, some industrial formulations selecrted as examples are presented. At the same time, the main methods of chemical-physical characterization of colloidal systems are illustrated, with particular regard to those based on radiation scattering and magnetic resonance spectroscopy.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Discussion of laboratory reports. Oral exam.	

Course: Formulation industry	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The initial objective of the course is to illustrate the various sectors of the formulation industry on the national and international scene. The general issues related to formulation will be addressed (Design of formulations and R&D techniques, industrial processes for formulation) which will subsequently be applied to specific cases chosen as examples.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Discussion of laboratory reports. Final oral exam and evaluation of the reports relating to the laboratory exercises.	

Course: Polymer formulations	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: B
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The course aims to provide the student with the skills necessary to deal with industrial problems related to the formulation of polymers and their mixtures, to obtain manufactured articles with targeted properties, according to different production technologies. In particular, the recent progress achieved in polymer blending technology and on the type and role of additives in polymer-based formulations will be illustrated, in applications involving materials with high resistance to impact, abrasion, fracture, surface coating and materials for special uses etc.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Discussion of laboratory reports. Oral exam	

Course: Rheology	Teaching Language: Italian
SSD (Subject Areas): ING/IND24	CREDITS: 6
Course year: II	Type of Educational Activity: C
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The course aims to: 1) illustrate the phenomenology related to the rheological behavior of Newtonian and non-Newtonian fluids, 2) provide useful tools for the rheological characterization of such fluids, 3) provide tools for the quantitative treatment of flow problems of interest in processes.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Discussion of laboratory reports. Oral exam	

Elective courses.

Course: Chemical Plants for the Sustainable Use of Resources	**Teaching Language: Italian**	
SSD (Subject Areas): **ING/IND25**		**CREDITS:** **6**
Course year: II	**Type of Educational Activity: D**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The student must demonstrate knowledge and ability to understand and to elaborate discussions concerning problems relating to distillation processes, chemical plants based on energy and matter transport phenomena with related environmental aspects, use of solar energy in chemical plants, energy valorization of civil and industrial waste. This will be achieved starting from the notions learned here and through the training course of the Teaching which intends to provide the Learner with the appropriate knowledge and methodological tools, also through applications to case studies. The student must demonstrate the ability to solve conceptual and design problems related to chemical plants for the sustainable use of resources.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Discussion of laboratory reports. Oral test consisting of a report on an assigned design paper.**		

Course: Thermoconversion processes of solids aimed at the production of energy.	**Teaching Language: Italian**	
SSD (Subject Areas): ING/IND25		**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The student must demonstrate knowledge and ability to understand and to process even complex discussions concerning issues relating to the use of alternative and traditional solid fuels, combustion and gasification processes with the removal of gaseous pollutants (e.g.: SO_2, CO_2), reuse of ashes and use of innovative technologies to reduce the environmental impact of chemical processes, also with a view to the circular economy. This will be achieved starting from the notions learned here and through the training course of the Teaching which intends to provide the Learner with the appropriate knowledge and methodological tools. The student must demonstrate the ability to solve conceptual and design problems related to combustion and gasification processes of solid fuels with relative attention to gaseous and solid pollutants produced.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Discussion of laboratory reports. Oral test.**		

Course: Biopesticides for agriculture.	**Teaching Language: Italian**	
SSD (Subject Areas): CHIM/06		**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The course intends to provide knowledge on natural organic substances that can be used to increase production, for the defense and conservation of agricultural heritage and the impact they can have on the environment. Furthermore, the aim is to provide the student with knowledge on the structure-biological activity correlation of natural bioactive organic substances produced by microorganisms and plants aimed at modulating their activity and specificity. The scale-up of promising herbicides, fungicides, insecticides and bactericides will be illustrated for the transfer of their production and formulation to the industrial level.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Discussion of laboratory reports. Oral test.**		

Course: Industrial Catalysis Laboratory.	**Teaching Language: Italian**
SSD (Subject Areas): CHIM/04	**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**
Teaching Methods: **In-person**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: **The training course is oriented towards transmitting the ability to propose solutions to problems encountered in the preparation, characterization and use of heterogeneous catalysts of interest to the Chemical Industry.**	
Pre-requisites: None **Is a pre-requisite for: None**	
Types of examinations and other tests: **Discussion of laboratory reports. Final oral exam and evaluation of the reports relating to the laboratory exercises.**	

Course: Design of experimenst for laboratory studies and formulation development.	**Teaching Language: Italian**
SSD (Subject Areas): CHIM/04	**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**
Teaching Methods: **In-person**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: **The student must demonstrate knowledge of the issues relating to the design of general and dedicated experiments, in particular, to the creation of industrial formulations by identifying the essential parameters that contribute to conferring certain final characteristics. He/she must demonstrate mastery of basic mathematical-statistical techniques for processing and interpreting the collected data. The student must demonstrate the ability to analyze real cases of designing experiments for laboratory studies and for formulations. He/she must also be able to plan a specific experimentation for the realization of industrial formulations or relating to a laboratory study (for example a kinetic study).**	
Pre-requisites: None **Is a pre-requisite for: None**	
Types of examinations and other tests: **Discussion of laboratory reports. Oral exam**	

Course: Polymerization catalysis	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: D
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: Mechanisms of enantioselective polymerization reactions and study of the relationships between the structure of catalysts, microstructure of polymer chains and physical properties of polymers. Olefin metathesis. Ring-opening polymerizations.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Final written and/or oral exam and evaluation of laboratory reports.	

Course: Chemical-Physics of Materials	Teaching Language: Italian
SSD (Subject Areas): CHIM/02	CREDITS: 6
Course year: II	Type of Educational Activity: D
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The aim of the course is to provide students with a complete overview of the experimental and theoretical methods for the description of the chemical-physical properties of condensed matter, with particular attention to the application of spectroscopies and computational models.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral exam	

Course: Polymer crystallography	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: D
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: Objective of the course is to provide students with a complete overview of the methods for the determination of the crystalline structure of polymers by X-ray and electron diffraction and molecular mechanics calculations for the determination of the conformation and packing of macromolecules in polymer crystals.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral exam	

Course: Dynamics and rheology of polymers	Teaching Language: Italian
SSD (Subject Areas): CHIM/04	CREDITS: 6
Course year: II	Type of Educational Activity: D
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: Study of the dynamics of macromolecules in bulk and in solution: viscoelasticity, Rouse model, reptant chain model and relaxation times. Model of the chain in the tube. Scaling laws of the longest relaxation time as a function of the length of the chains. Mechanical tests on the theory of reptation. Spectroscopic techniques for analyzing the structure and dynamics of macromolecules in solution and in mass: NMR and scattering techniques.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Discussion of laboratory reports Possible written and/or oral tests in progress. Final written and/or oral exam. Computer exercise.	

Course: Polymers for biomedical applications	**Teaching Language: Italian**	
SSD (Subject Areas): CHIM/04		**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **The aim of the course is to provide students with an overview of the synthetic and natural polymeric materials most commonly used for the manufacture of systems of biomedical interest. The main objective is the study of the relationships between chemical composition, structure and properties of the different polymers and their final biomedical application.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Oral exam.**		

Course: Computational methods for the study of reactions of industrial interest	**Teaching Language: Italian**	
SSD (Subject Areas): CHIM/04		**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**	
Teaching Methods: **In-person**		
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:		
Learning objectives: **Analysis of computational methods applied to reactions of industrial interest. Transformation reactions of aldehydes and ketones. Reactivity of transition metals in the formation of C-C and C-H bonds. Computational modeling of polymerization, epoxidation and hydroformylation reactions. Analysis of metathesis reactions. Meerwein-Pondorf-Verley reduction reactions.**		
Pre-requisites: None **Is a pre-requisite for: None**		
Types of examinations and other tests: **Final written and/or oral exam and evaluation of laboratory reports.**		

Course **Exercises in Physical Chemistry of Formulations**	**Teaching Language: Italian**
SSD (Subject Areas): CHIM/02	**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**
Teaching Methods: **In-person**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: **The training course aims to acquire specialist skills in the sector, which can be used in the world of work. Through the discussion of theoretical principles concerning colloidal systems and following the related modelling, design, preparation and characterization, the student acquires knowledge and skills suitable for a profitable entry into the formulation industry.**	
Pre-requisites: None **Is a pre-requisite for: None**	
Types of examinations and other tests: **Oral exam**	

Course **Chemistry of Advanced Materials**	**Teaching Language: Italian**
SSD (Subject Areas): CHIM/03	**CREDITS: 6**
Course year: II	**Type of Educational Activity: D**
Teaching Methods: **In-person**	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: **Synthetic, structural, chemical-physical aspects and the potential applications of some classes of advanced materials will be illustrated, with particular regard to those for applications in electronics and photonics.**	
Pre-requisites: None **Is a pre-requisite for: None**	
Types of examinations and other tests: **Oral exam**	

Course Environmental Chemistry (and Sustainability)	Teaching Language: Italian
SSD (Subject Areas): CHIM/12-CHIM/01	CREDITS: 6
Course year: II	Type of Educational Activity: D
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The aim of the course is to provide knowledge of the chemistry of the environment and the natural and anthropic processes that can modify it; moreover, hints are given on the methodologies applied to optimize the use of natural resources and reducing the consumption of energy and raw materials.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Discussion of student report, power point presentation and oral exam.	

Course Principles of protein engineering for cell factories	Teaching Language: Italian
SSD (Subject Areas): BIO/10	CREDITS: 6
Course year: II	Type of Educational Activity: D
Teaching Methods: In-person	
Contents extracted from the SSD declaratory list consistent with the learning objectives of the course:	
Learning objectives: The course is aimed at acquiring the basics of the molecular organization of the cell, bioinformatics strategies for design and molecular biology for the construction and industrial use of engineered proteins with new characteristics (stability, reaction specificity, etc.). Some model-cases selected from the most recent literature will be proposed.	
Pre-requisites: None Is a pre-requisite for: None	
Types of examinations and other tests: Oral exam	