PhD Programme in CHEMICAL SCIENCE AND TECHNOLOGY in collaboration with the University of Sassari	
DISCIPLINARY SCIENTIFIC AREAS	02 - PHYSICAL SCIENCES; 03 - CHEMICAL SCIENCES; 09 - INDUSTRIAL AND INFORMATION ENGINEERING
COORDINATOR	PROF. CARLA CANNAS
HEAD DEPARTMENT	DEPARTMENT OF CHEMICAL AND GEOLOGICAL SCIENCES
DURATION	3 YEARS
LEARNING OUTCOMES AND RESEARCH TOPICS	The activity of the PhD in Chemical Sciences and Technologies mainly includes 17 key research topics that constitute the cultural basis of PhDs. Within them, the training of the PhD provides a specific and personalized program with the aim of orienting the pre-existing basic preparation of the PhD student towards the acquisition of specialized skills, beside the general methodological aspects of the research approach. The main issues proposed for the research activities are the following: **1. Innovative nanostructured materials.** Synthesis and advanced characterization of new nanomaterials for specific applications (e.g. catalysis, biomedicine, sensing, environment, energy, cultural heritage). **2. Physical chemistry of biological systems.** Experimental and theoretical studies of complex biological systems and use of advanced techniques (NMR, diffraction, microscopies). **3. Modeling and computational chemistry.** Development of simulation techniques, computational studies of complex systems of chemical interest. **4. Industrial catalytic processes.** Chemical process technologies. Study of catalytic processes (catalysts preparation, stability and regeneration). **5. Industrial biotechnologies.** Processes based on enzymatic catalysis, methods of physical and chemical immobilization and industrial applications. **6. Analytical chemistry and surface technology.** Study of the reactivity of thin oxide layers on metallic materials with technological applications (for example: corrosion, heterogeneous catalysis, tribology and biocompatible materials). Reactivity of minerals, asbestos and atmospheric particulate surfaces in biotic and abiotic environment. **7. Surfactants and nanotechnological applications.** Systems based on nanostructured surfactants and applications in the field of pre-formulations (NMR studies of the local structure, SAXS). **8**. **Conventional extraction technologies and based on supercritical fluids.** Technologies based on the use of fluids in supercritical conditions for extraction and separation of plant active ingredients and for technological treatments. **9. Synthesis and reactivity of organic molecules.** Study of reactions promoted by metals and organic catalysts for the enantio, diastereo- and regioselective synthesis of molecules with biological activity and natural products. Developments of novel low-environmental impact synthetic strategies. **10. Non-conventional organic synthesis methodologies with low environmental impact**. **11. Synthesis, characterization, properties and reactivity of new inorganic or organometallic compounds.** Structural, spectroscopic, computational characterization and catalytic, biological and pharmacological properties. **12**. **Molecular materials**. Synthesis of mono and multifunctional molecular

	materials (coordination complexes and 2D and 3D coordination polymers) with electrical and/or magnetic and luminescence properties with applications in electronics, spintronics and in sensing of environmental pollutants. Synthesis and development of molecular fluorescent and redox sensors for metal ions and inorganic anions. Reactivity studies, molecular spectroscopies, equilibria in solution and calculation methodologies, solid state. **13. Analytical methodologies and applications.** Methods for the determination of analytes of interest in food, environment, and biomedicine. Design, synthesis and characterization of the complex-formation equilibria of ligands for toxic metals in human pathologies. Study of equilibria in solution: experimental techniques and calculation methods. **14. Design, synthesis and biological evaluation of small molecules**. Synthesis, characterization and biological evaluation of new chemical structures with potential pharmacological activity. **15. Pharmaceutical chemistry and technology.** Design and development of nanosystems for site-specific delivery of bioactive molecules and for diagnostics / theranostics. Design and testing of innovative platforms for the delivery of drugs through different routes of administration. **16. Pharmaceutical and toxicological chemical analysis**. Validation of analytical methodologies for the determination of drugs and metabolites in biological matrices. **17. Cultural heritage and conservation techniques**. Innovative strategies and materials for conservation of cultural heritage. Archaeometry studies and application of modern non-destructive and portable in-situ diagnostic techniques. The PhD programme aims to train highly qualified young scientists in the field of chemistry, offering to young Italian and foreign graduates the opportunity to independently develop an original and innovative research project in the most advanced fields of chemical sciences and technologies. To this end, PhD students are trained, within the different research topics, through a constant experimental and / or theoretical research activity and an appropriate educational path. The PhD student will acquire the knowledge, the scientific method and will develop a careful critical spirit to carry out high-level research activities in multiple interdisciplinary fields of interest in Chemistry both nationally and internationally. The centrality of Chemical Sciences is widely recognized and has a transversal character to different scientific disciplines (physics, biology, engineering, geology, pharmacy, archeology) for which it finds applications in a wide variety of fields ranging from materials science to biomedicine, from energy to agriculture, from electronics to biology, from the conservation of cultural heritage to the environment protection. This training path will allow the PhD to acquire a deep basic as well as specialized knowledge that will allow him to actively contribute to the progress of chemical sciences both in the industrial field and in the academic one, in a context of global international competition. To achieve this goal, the PhD student is offered the opportunity to come into contact with national and foreign researchers and research institutions and to carry out a period of research activity abroad, in highly qualified foreign research institutions and to get in touch with the world of industry. In addition, the Doctoral Course provides a great variety of advanced courses and seminars for PhD students

	and it promotes the participation to national and international schools, workshops and conferences.
ELIGIBILITY AND OTHER REQUIREMENTS FOR CANDIDATES (ART. 2 - NOTICE OF COMPETITION)	LM-6 Biologia LM-8 Biotecnologie industriali LM-11 Scienze per la conservazione dei beni culturali LM-13 Farmacia e farmacia industriale LM-17 Fisica LM-22 Ingegneria chimica LM-53 Scienza e ingegneria dei materiali LM-54 Scienze chimiche Foreign candidates: Similar qualification awarded abroad and declared equivalent by the PhD Academic Board, for the only purpose of admission to the PhD programme.
ADMISSION TESTS	ASSESSMENT OF QUALIFICATIONS AND CURRICULUM VITAE, AND INTERVIEW The interview will be aimed at verifying the candidate's ability to orient himself/herself on the main fields of study related to the Doctorate and to verify his/her knowledge in chemical sciences and technologies, skills of analysis, elaboration and communication, and can take place, at the request of the candidate, also in English. During the interview, the candidate will discuss his/her 3-year research project. The project (preferably written in English) must be uploaded along with the documents listed in art. 3 of the PhD notice of competition (*Annex A "Titoli valutabili e Curriculum Vitae'; Annex B 'Dichiarazione sostitutiva di certificazioni del/i titolo/i di accesso con esami e voti'; two-sided coloured scanned copy of a valid ID, with a clear photo*), within the deadline (file name: progetto_di_ricerca_surname_name - formatting requirements: min. 8,000 max 16,000 characters including spaces - excluding title, schemes, charts and bibliographic references). The project will be evaluated during the interview exclusively and must include: i) purpose of the proposed research project; ii) state of the art of research; iii) detailed workplan; iv) expected results. During the interview, the candidate's language skills in English will be also assessed. His/Her exposition skills, clarity in describing the objectives and methods of the project, as well as the accuracy of his/her scientific language will also be evaluated. Candidates who are unable, for justified reasons, to take the interview at the established location, may be given the opportunity to conduct it by teleconference, on the same date and time established for face-to-face interviews, according to the instructions of the notice of competition.
ADMISSION TESTS FOR FOREIGN CANDIDATES APPLYING FOR RESERVED POSITIONS SUPPORTED BY A SCHOLARSHIP	ASSESSMENT OF QUALIFICATIONS AND CV, VIDEO CONFERENCE INTERVIEW The interview will focus mainly on the experiences gained by the candidate in the topics specific to the Doctorate and on the topics that he/she would propose as a possible object of the activity to be developed during the three-year PhD programme. During the interview, the candidate will discuss a three-year research project, which must be submitted in addition to the documents required in art. 3 of the notice of competition (*certificate attesting the award of a 2nd*

	level foreign degree needed to access a PhD programme, including exams and marks, with a translation in Italian or English; certificate attesting the award of a 1st level foreign degree, including and marks, with a translation in Italian or English; signed Curriculum Vitae preferably in EU format, in English or Italian; up to 3 reference letter(s), in English or Italian, on institutional letterhead paper, dated and signed by a university professor or expert in the PhD scientific area(s), following the prescriptions of each annex; additional qualifications, certifications, publications (up to 5) and work experiences, detailed in English or in Italian; two-sided coloured scanned copy of a valid ID, with a clear photo), within the deadline (file name: research project_surname_name). The project (min. 8,000, max. 16,000 characters, title and references excluded), evaluated exclusively during the interview, should specify: i) purpose of the proposed research project; ii) state of the art of research; iii) detailed workplan; iv) expected results. During the interview, the candidate's language skills in English will be assessed. His/Her exposition skills, clarity in describing the objectives and methods of the project, as well as the accuracy of his/her scientific language will also be evaluated. Reference letters must be written in English, using the form available on the webpage https://unica.it/dottoratiricerca (How to apply for PhD selection: Guidelines and forms- Annex C), by a university professor or an expert in the research fields of the PhD programme, on letterhead of their institution, dated and signed. Evaluators will send their letters directly to the email address phdcall_referenceletter@unica.it (object: surname and name of the candidate being evaluated and name of the PhD programme for which he/she is applying).
POSITIONS	8
SCHOLARSHIPS	4 funded by MUR PL, 1 of which reserved for foreign candidates with a degree awarded abroad 3 funded by the University of Sassari
POSITIONS WITHOUT SCHOLARSHIP	1
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