Università degli Studi di Cagliari

PhD Programme in CHEMICAL SCIENCE AND TECHNOLOGY in collaboration with the University of Sassari	
DISCIPLINARY SCIENTIFIC AREAS	03 – CHEMICAL SCIENCES; 09 – INDUSTRIAL AND INFORMATION ENGINEERING; 02- PHYSICAL SCIENCES
COORDINATOR	PROF. CARLA CANNAS
HEAD DEPARTMENT	DEPARTMENT OF CHEMICAL AND GEOLOGICAL SCIENCES
DURATION	3 YEARS
LEARNING OUTCOMES AND RESEARCH TOPICS	The aim of Chemical Science and Technology PhD Course is to train highly qualified young scientists throughout science and research, by giving an opportunity to young Italian and foreigner master-degree level candidates in order to plan and carry out a research project in the most advanced issues of chemical sciences and technologies. To this end the selected PhD students are accompanied and supported with a continuous experimental activity sustained by a tailored teaching path. To achieve this target we offer to the PhD students the possibility to interact with institutions, industries and scientists active in the national and international panorama, to spend a period in selected international laboratories and to participate to conferences, workshops and summer schools. 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, sensors, 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, environmental 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

	morphological properties). **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. Thermodynamics of mixtures.** Thermodynamic characterization of mixtures made up of ionic liquids and/or molecular compounds by volumetric, calorimetric and rheological techniques. Comparison with the results obtained through complementary experimental and computational techniques. **10. Synthesis and reactivity of organic molecules.** Study of reactions promoted by metals and organic catalysts for the enantio, diastereal and regio-selective synthesis of molecules with biological activity and natural products. Developments of novel low-environmental impact synthetic strategies. **11. New organic synthesis methodologies**. Development of new cross coupling reactions for the preparation of conventional functional groups starting from unconventional reactants. **12. Synthesis, characterization, properties and reactivity of new inorganic or organometallic compounds.** Structural, spectroscopic, computational characterization and catalytic, biological and pharmacological properties. **13. Precursors and molecular materials.** Organic and inorganic synthesis of molecules rich in sulfur and / or selenium with possible applications for the extraction of noble metals or as anticarcinogens and as precursors of materials of interest in optics and electronics. Synthesis and development of fluorescence and redox molecular sensors for metal ions and inorganic anions. Reactivity studies, molecular spectroscopies, solution equilibria and calculation methodologies, solid state. **14. Analytical methodologies and applications.** Synthesis and characterization of organic and metallorganic-based materials for technological applications (sensors, luminescence, photovoltaic devices). 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. **15. Design, synthesis and biological evaluation of small molecules**. Synthesis, characterization and biological evaluation of new chemical structures with potential pharmacological activity. **16. 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. **17. Pharmaceutical and toxicological chemical analysis**. Validation of analytical methodologies for the determination of drugs and metabolites in biological matrices. **18. 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.
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.
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	9
SCHOLARSHIPS	2 FUNDED BY MUR "2019-2020 PLANNING EX ART. 1 D.M. N. 435/2020 STATE UNIVERSITIES" 1 FUNDED BY MUR PL, RESERVED FOR FOREIGN CANDIDATES HOLDING A FOREIGN DEGREE 3 FUNDED BY THE UNIVERSITY OF SASSARI; 1 FUNDED BY FLUORSID ALKEEMIA SPA, research topic "*Development of electrolytes based on fluorinated-salts and organic carbonates for lithium batteries*" – REFERENCE PERSON Prof. Carla Cannas The recipients for the scholarship related to a specific topic will be selected among the candidates who will gain a suitable position in the ranking lists for the admission to the PhD programme, as well as a positive assessment as regards the adequacy of his/her CV to develop the specific topic.
POSITIONS WITHOUT SCHOLARSHIP	2
REFERENCE PERSON	PROF. CARLA CANNAS EMAIL: ccannas@unica.it - TEL. +39 0706754380
WEBSITE	https://people.unica.it/dottoratoinchimica/courses/; https://www.uniss.it/didattica/offerta-formativa/formazione-post-laurea/dottorati-di-ricerca