

Syllabus

Course Description

Course Title	Instrumental Analytical Techniques
Course Code	40466
Course Title Additional	
Scientific-Disciplinary Sector	AGRI-06/B
Language	German
Degree Course	Bachelor in Food and Enogastronomy Sciences
Other Degree Courses (Loaned)	
Lecturers	Dott. Raphael Tiziani, Raphael.Tiziani2@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/38727
Teaching Assistant	
Semester	Second semester
Course Year/s	2
CP	6
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	The course provides a comprehensive introduction to the fundamentals of quali-quantitative analytical and instrumental chemistry, enabling students to select appropriate methods based on specific problems and to assess the potential applications of modern analytical procedures. Through an in-depth exploration of analytical processes, sample preparation, and essential analytical methods, students will develop the skills necessary to make informed decisions in various analytical contexts. The course covers key topics including the foundations of analytical chemistry, with a focus on the analytical process, as well as the application of statistical methods and probabilities in analytical procedures. It

	also delves into the principles and techniques of sample preparation, chromatography, liquid chromatography, gas chromatography, mass spectrometry, infrared spectroscopy, and electron ultraviolet-visible spectroscopy. Additionally, the course examines advanced coupling techniques, such as the integration of liquid chromatography with mass spectrometry and gas chromatography with mass spectrometry. The integrated approach of teaching and lab work ensures that students acquire both theoretical knowledge and practical insights into the field of analytical chemistry.
Course Topics	The course covers the following topics: Introduction to Analytical Chemistry: Analytical Chemistry and the Analytical Process Statistics and Probability, Procedures in Analytical Chemistry Sample Preparation Fundamentals of Chromatography Liquid Chromatography (LC) Gas Chromatography (GC) Mass Spectrometry (MS) Infrared Spectroscopy (IR) Electronic UV/VIS Spectroscopy Hyphenated Techniques (LC/MS, GC/MS)
Keywords	Analytical Chemistry, Sample Preparation, Chromatography, Spectroscopy, Mass Spectrometry
Recommended Prerequisites	
Propaedeutic Courses	
Teaching Format	The course combines lectures with exercises and practical learning activities. During the lectures, occasional visits to the laboratory are organized, allowing students to become familiar with the analytical instruments covered in class and to gain a practical understanding of their operation and applications. The practical component of the course, including laboratory activities, is supervised and conducted by the lecturers and/or Teaching Assistants. PowerPoint presentations used during the course are made available to students via Microsoft Teams. Additional teaching and

	learning materials are provided by the lecturers as needed.
Mandatory Attendance	No
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding: Upon completion of their studies, graduates with a bachelor's degree in Food and Enogastronomy Sciences will have acquired a solid foundation of scientific knowledge in disciplines such as chemistry, physics, biology, mathematics, computer science, and law, specifically applied to the food and gastronomic sector. They will gain technological skills for managing production and transformation processes, along with an integrated view of the quality, safety, and sustainability of food supply chains and systems. In addition, graduates will understand the principles related to waste reduction, resource optimization, and the reconciliation of economics and ethics, which are central elements for addressing the modern challenges of the agri-food system. The knowledge and understanding skills mentioned above are acquired through participation in lectures, practical exercises, seminars, and through guided personal study and individual study as provided by the activated educational activities. The verification of the achievement of learning outcomes is mainly carried out through exams and any interim tests. The tests may be written and/or oral, and may also consist of reports and oral presentations of projects or seminars. Ability to apply knowledge and understanding: Students will be able to practically apply the knowledge they have acquired, developing the ability to solve complex problems in the food and gastronomic sector. Thanks to a wide range of practical activities, such as laboratories, internships, workshops, and seminars, they will be able to use chemical, physical, sensory, and microbiological analysis methods to evaluate the quality and safety of food and production processes. Graduates of the first profile will be able to manage food processing and preservation processes, design new technological solutions, and apply knowledge of plant genetics and process planning to ensure the quality of the final product. Graduates of the second profile will have advanced skills in managing restaurant businesses, promoting gastronomic heritage, and applying

	fermentation techniques and food design. In both paths, the ability to enhance by-products and reduce waste will be central, contributing to the sustainable innovation of the sector. The educational activities are designed to strengthen the autonomy of judgment and the ability to make decisions in complex contexts, as well as to develop communication skills and the ability to work in multidisciplinary and international teams. At the end of the program, graduates will be able to independently apply their knowledge in professional contexts, promoting innovative and sustainable solutions for the challenges of the agri-food and gastronomic system. The achievement of the ability to apply knowledge is accomplished through critical reflection on the texts proposed for individual study, stimulated by classroom activities, the study of research and application cases presented by the professors, the performance of practical laboratory exercises, fieldwork, bibliographic research, the completion of individual and/or group projects included in the core and elective courses of the curriculum, as well as during internships and the preparation of the final exam. The assessments, carried out through written and/or oral exams, reports, and exercises, involve the completion of specific tasks in which the student demonstrates mastery of tools, methodologies, and critical autonomy. During internships, the assessment is conducted through the presentation of a report by the student to the supervising professor. Making judgements: Evaluate and critically analyze the quality, safety, and sustainability of production processes and food products, considering scientific, technological, economic, and cultural aspects. Students will be able to make informed decisions based on scientific data and the analysis of production contexts to ensure the excellence of the final product. Express independent judgments regarding innovative techniques for the transformation and enhancement of food and gastronomic productions, evaluating the risks and opportunities associated with the introduction of new technologies or business models, both locally and internationally. Interpret and manage complex data collected through chemical, physical, microbiological, and sensory analyses, in order to improve
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	the quality of food products and effectively respond to food safety needs and regulatory requirements of the sector. Communication skills: Communicate effectively and appropriately with both technical and non-technical interlocutors, including professionals in the food and gastronomic sector, public and private institutions, and the general public. This includes the ability to adapt the communication style based on the audience, using the specific technical language of the food and gastronomic sector when necessary. Present and discuss the results of their analyses and research in both written and oral form, using technological and multimedia tools. Graduates will be able to draft technical reports, research papers, and scientific documents, as well as present their results clearly and structured, for example during conferences, seminars, or business meetings. Actively participate in discussions and group work in multidisciplinary and international contexts, demonstrating active listening, negotiation, and collaboration skills. Practical experiences and internships will provide students with the abilities to work effectively in teams and contribute to solving complex problems in the sector. Use the three languages of instruction of the course (Italian, German, and English) fluently and confidently, both for written and oral communication. Thanks to the trilingual approach of the Free University of Bozen-Bolzano, graduates will be able to face international work contexts, participate in global networks, and contribute to the development of international cooperation projects to address the challenges of the food and gastronomic sector. Learning skills: At the end of the degree program, graduates will have developed strong learning skills, essential for successfully continuing academic studies and entering the workforce. In particular, they will be able to: Learn autonomously and continuously, keeping up to date with scientific and technological advancements in the food and gastronomic sector. Graduates will have acquired study methods and research tools that will allow them to independently update
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	their skills, critically interpreting new knowledge. Effectively manage the learning of complex concepts by integrating the various scientific and technical disciplines covered in the degree program, such as chemistry, biology, food technologies, economics, and law. They will be able to identify the most relevant sources, understand and apply new methodologies, and adapt to sector developments. Develop collaborative learning strategies, thanks to the experience gained through group work, internships, and laboratory activities. Graduates will be able to share their knowledge and learn from others, demonstrating adaptability and teamwork skills. Continue their studies independently in Master's degree programs (such as the LM-70 class, Food Science and Technology, currently offered at the same university) or in other related fields, using the skills and methods acquired during the bachelor's degree to tackle new learning challenges, even in high-level academic and professional contexts.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Assessment is conducted through an oral examination covering: a) Theoretical questions on the topics and analytical methods covered in the course. b) Application and transfer questions based on specific case studies, requiring students to select and justify appropriate analytical methods. c) Questions on laboratory experience, including the methods, instruments and potential sources of error encountered during practical activities.
Evaluation Criteria	The examination assesses the clarity and accuracy of the answers, the appropriate use of subject-specific terminology, as well as the students' ability to synthesize information and make sound judgments. Particular attention is also given to the ability to establish connections between different topics, critically evaluate analytical questions, and independently summarize concepts in a clear and structured manner.

Required Readings	Daniel C. Harris, CHIMICA ANALITICA QUANTITATIVA, Zanichelli, Bologna, 2005 Douglas A. Skoog, Fundamentals of Analytical Chemistry, 7th Edition
Supplementary Readings	
Further Information	
Sustainable Development Goals (SDGs)	Good health and well-being, Quality education, Clean water and sanitation, Industry, innovation and infrastructure, Peace, justice and strong institutions, Responsible consumption and production, Climate action, Life below water, Life on land, Sustainable cities and communities