Syllabus

Course Description

Course Title	Principles of General, Organic, and Biological Chemistry for Food Science
Course Code	40452
Course Title Additional	
Scientific-Disciplinary Sector	
Language	English
Degree Course	Bachelor in Food and Enogastronomy Sciences
Other Degree Courses (Loaned)	
Lecturers	Prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30124
Teaching Assistant	
Semester	First semester
Course Year/s	1st
CP	9
Teaching Hours	54
Lab Hours	36
Individual Study Hours	135
Planned Office Hours	18
Contents Summary	The course provides foundational knowledge of chemistry and biochemistry as applied to food sciences. Students will explore key topics, including atomic theory, chemical bonding, chemical reactions, and the chemistry of macronutrients such as carbohydrates, lipids, and proteins. Aerobic and anaerobic metabolism will also be examined, highlighting their roles in energy production and food systems.
Course Topics	Part 1 – General Chemistry Introductory concepts

	Measurement units and conversions Basic chemical calculations Relationships between matter and energy Matter and transformations Properties of matter Physical vs. chemical changes Conservation of energy in natural and industrial processes Atomic structure Evolution of atomic theories ¿ modern atomic model Subatomic particles: protons, neutrons, electrons Orbitals and electronic configuration Chemical bonds Ionic, covalent, metallic Influence on physical and chemical properties of substances Elements, ions, and compounds Chemical nomenclature and classification rules Chemical reactions Reaction mechanisms and balancing Applied aspects Heavy metal accumulation in food Health risks, monitoring, and control methods Part 2 – Organic Chemistry Introduction to organic compounds Bonding in carbon (catenation, hybridization) Functional groups and classification of organic molecules Main classes of organic compounds Hydrocarbons: alkanes, alkenes, alkynes, aromatics Alcohols, phenols, ethers Aldehydes and ketones Carboxylic acids and derivatives (esters, amides) Amines Stereochemistry Isomerism: structural and stereoisomers Chirality and optical activity Organic reactions Addition, substitution, elimination, oxidation/reduction Part 3 – Biochemistry Biological catalysis

	Enzymes: function, specificity, regulation Biomolecules and nutrition Carbohydrates Lipids Proteins and amino acids (overview) Vitamins and minerals Role in metabolism and nutritional quality of food Cellular biology foundations Structure and function of cells Key biochemical pathways Cellular respiration Aerobic respiration Glycolysis Krebs cycle (citric acid cycle) Electron transport chain ¿ ATP production Anaerobic respiration Implications in food and wine production
Keywords	Atom Chemical bond Reactions Carbon Functional groups Stereochemistry Enzymes Biomolecules Metabolism
Recommended Prerequisites	
Propaedeutic Courses	None
Teaching Format	Teaching encompasses lectures that convey the theoretical concepts of chemistry and biochemistry as applied to the food and wine sector. These are complemented by practical laboratory activities, designed to develop technical skills and to consolidate the knowledge acquired through experimental work. Additionally, educational visits to companies in the sector are planned to promote the practical application of course content and provide students with direct contact with the business environment.
Mandatory Attendance	No
Specific Educational	Knowledge and understanding:

Objectives and Learning Outcomes	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. Apply ethical and sustainable approaches, reconciling economic needs with environmental and social requirements. Graduates will

	be able to identify solutions to reduce waste, enhance by-products, and optimize resource use, proposing food production models in line with the principles of the circular economy. 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 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 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	The final assessment will consist of an oral exam, and there will also be written midterm tests.
Evaluation Criteria	- Knowledge of Key Concepts (40%) - Application and Critical Thinking (30%) - Integration of Topics (15%) - Communication Skills (10%)

	- Engagement and Argumentation (5%)
Required Readings	• *Lecture Slides and Teaching Materials for General Chemistry and Biochemistry*. Provided by the Professor. • Robert B. Jordan. *Principles of Inorganic Chemistry: Basics and Applications*. Cham: Springer, 2024. • David L. Nelson, Michael M. Cox, and Aaron Hoskins. *Lehninger Principles of Biochemistry*. 8th ed. New York: W. H. Freeman, 2021.
Supplementary Readings	
Further Information	
Sustainable Development Goals (SDGs)	Zero hunger, Good health and well-being, Quality education, Partnerships fot the goals, Responsible consumption and production, Life on land, Industry, innovation and infrastructure

Course Module

Course Constituent Title	General Chemistry and biochemistry
Course Code	40452A
Scientific-Disciplinary Sector	AGR/13
Language	English
Lecturers	Prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30124
Teaching Assistant	
Semester	First semester
CP	6
Responsible Lecturer	
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	This course introduces fundamental concepts of chemistry and

	biochemistry as they relate to food and wine sciences. Topics include measurements and calculations, matter and energy, atomic theory and the atom, chemical bonding, elements and ions, and nomenclature. It also covers chemical reactions, chemical composition, gases, and heavy metals residuals in food. The biochemistry section focuses on enzymes, carbohydrates and lipids, vitamins and minerals and introduces cellular biology and biochemistry. Topics related to cellular respiration include aerobic harvesting of energy, the stages of cellular respiration (glycolysis, the Krebs cycle, and the electron transport chain), and anaerobic respiration.
Course Topics	
Teaching Format	Teaching encompasses lectures that convey the theoretical concepts of chemistry and biochemistry as applied to the food and wine sector. These are complemented by practical laboratory activities, designed to develop technical skills and to consolidate the knowledge acquired through experimental work. Additionally, educational visits to companies in the sector are planned to promote the practical application of course content and provide students with direct contact with the business environment.
Required Readings	• *Lecture Slides and Teaching Materials for General Chemistry and Biochemistry*. Provided by the Professor. • David L. Nelson, Michael M. Cox, and Aaron Hoskins. *Lehninger Principles of Biochemistry*. 8th ed. New York: W. H. Freeman, 2021. • Robert B. Jordan. *Principles of Inorganic Chemistry: Basics and Applications*. Cham: Springer, 2024.
Supplementary Readings	• Vassilis Kontogiorgos. *Introduction to Food Chemistry*. 2nd ed. Cham: Springer, 2024.

Course Module

Course Constituent Title	Organic Chemistry
Course Code	40452B
Scientific-Disciplinary Sector	CHIM/06

Language	English
Lecturers	Dr. Stefano Benini, Stefano.Benini@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/27433
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	18
Lab Hours	12
Individual Study Hours	45
Planned Office Hours	9
Contents Summary	Properties and nomenclature of organic compounds - Alkanes, alkenes, alkynes. - Stereochemistry and chirality. - Alcohols, phenol, ether, thiols. - Aldehydes and ketones. - Carboxylic acids and derivatives - Amines. - Benzene and aromatic compounds. - Structure and function of bioorganic molecules (e.g., proteins, DNA)
Course Topics	
Teaching Format	Lectures with the use of power point presentations and laboratory practice. The material will be available in the Open Learning Environment (OLE) website.
Required Readings	Brown, William H.; Novak, Bruce M. "Organic chemistry" ISBN: 978-1-305-58035-0 present in the library
Supplementary Readings	Organic chemistry books present in the library