CHEMISTRY AND FOOD SCIENCE

Chair: Carol L. Russell

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The Department of Chemistry and Food Science is unique in that it offers strong majors in both Chemistry and Food Science. The programs complement each other, producing Food Science majors with an exceptionally strong background in chemistry and providing Chemistry majors with the opportunity to take electives in more applied areas such as food chemistry, food engineering, and food analysis. Undergraduate research opportunities are also enhanced by the combination of these program areas. One of the three chemistry concentrations is approved by the American Chemical Society (ACS); the other chemistry concentrations may be taken along with a Secondary Education minor.

The ACS-approved curriculum allows flexibility to specialize in a particular area through choice of the elective, the advanced course, and the senior research project. The two other chemistry options require a minor to be taken concurrently. The General Chemistry concentration requires a minor in secondary education or one of the following areas: business, computer science, earth science, or mathematics. The Biochemistry concentration requires a minor in secondary education or one of the following areas: biology, business, communication arts, journalism, mathematics, or nutrition. Two concentrations are possible with the Food Science major: Food Science and Technology and Applied Food Science; the latter concentration requires a concurrent minor in biology, business, or nutrition. An excellent undergraduate education is provided by the structured curriculum for both the Chemistry major and for the Food Science major coupled with a strong general education component. The strength of these programs is clearly indicated by the excellent graduate school placement and achievement records and by the employment opportunities enjoyed by Department graduates.

Preprofessional Program
A preprofessional curriculum for pre-medical, pre-dental, and pre-veterinary studies is also offered in cooperation with the Biology Department (see page 83 of this catalog).

The General Education Requirement
All students must satisfy a general education requirement consisting of eleven (11) courses outside of the major department (see page 58). The General Education Goal 6 (Physical Science) and laboratory requirement are satisfied through the completion of both Chemistry and Food Science majors.

Course Prerequisites
Courses may have specified conditions for enrollment, such as prior completion of less advanced courses, permission of the instructor, or appropriate placement test scores. Students should refer to course descriptions in the department listings for prerequisite requirements.

CHEMISTRY MAJOR

All students majoring in Chemistry must choose one (1) of the three (3) concentrations: ACS-Approved Program, General Chemistry, or Biochemistry.

AMERICAN CHEMICAL SOCIETY APPROVED CONCENTRATION (CHA)

Department Requirements:

*33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.302 Biochemistry I - Structures, Mechanisms and Analysis
33.303 Physical Chemistry I
33.304 Physical Chemistry II
33.321 Instrumental Analysis
33.401 Inorganic Chemistry
33.497 Chemical Research I
33.498 Chemical Research II
**33.__ An Advanced Chemistry course
43.219 Calculus I (Gen.Ed. Goal 2)
43.220 Calculus II
43.221 Calculus III
53.211 Principles of Physics I
53.212 Principles of Physics II
63.___ Two Semesters of
63.___ Computer Science

**Students excused from 33.107 Principles of Chemistry must substitute an elective.*

***The course in advanced chemistry can be 33.409 Biochemistry II-Nutritional Biochemistry/Metabolism; 33.411 Advanced Organic Chemistry-Reactions and Synthesis; 33.412 Advanced Organic Chemistry-Mechanism and Structure; 33.414 Advanced Physical Chemistry; 33.416 Advanced Inorganic Chemistry; or 33.421 Advanced Analytical Chemistry, depending upon interest and graduate study pursuits. One or possibly two of these courses will be offered each year. The decision on which of the advanced courses will be offered is made during the fall semester of an academic year, in consultation with senior chemistry students who will be graduated the following May.*

The American Chemical Society approved Chemistry major provides an excellent science background for careers in the field of biotechnology. Additional courses, selected from the following list, would enhance that background. Students wishing to pursue employment or graduate work in the field of biotechnology should select elective and general education courses from the following:

23.101 Biological Concepts
23.301 Genetics
23.307 Principles of Microbiology
23.340 Immunology
23.414 Cell Culture
23.435 Recombinant DNA Techniques

GENERAL CHEMISTRY CONCENTRATION (CHG)

Department Requirements

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.303 Physical Chemistry I
33.304 Physical Chemistry II
33.321 Instrumental Analysis
33.401 Inorganic Chemistry

43.219 Calculus I (Gen.Ed. Goal 2)
43.220 Calculus II
43.221 Calculus III
53.211 Principles of Physics I
53.212 Principles of Physics II
63.120 Introduction to Information Technology **or**
63.152 Computer Science I Using Java

A minor in secondary education or in one the following areas is required with the General Chemistry concentration: business, computer science, earth science, or mathematics. Other minors may be approved by the Department of Chemistry and Food Science.

BIOCHEMISTRY CONCENTRATION (CHB)

Department Requirements

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.302 Biochemistry I - Structures, Mechanisms and Analysis **or**
33.301 Biochemistry
33.303 Physical Chemistry I
33.409 Biochemistry II - Nutritional Biochemistry/Metabolism
23.101 Biological Concepts (Gen.Ed. Goal 7)
23.272 Human Anatomy and Physiology I
23.273 Human Anatomy and Physiology II **or**
23.301 Genetics **or**
23.260 Cell Biology
43.219 Calculus I (Gen.Ed. Goal 2)
43.220 Calculus II
53.211 Principles of Physics I
53.212 Principles of Physics II
63.120 Introduction to Information Technology **or**
63.152 Computer Science I Using Java

A minor in secondary education or in one the following areas is required with the Biochemistry concentration: biology, business, communication arts, journalism, mathematics, or nutrition. Other minors may be approved by the Department of Chemistry and Food Science.

PROGRAM IN EDUCATION

Chemistry majors with a concentration in either General Chemistry or Biochemistry may minor in secondary education to obtain Initial licensure at the high school level.

MINOR IN CHEMISTRY (6 COURSES)

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.303 Physical Chemistry I
33.304 Physical Chemistry II

MINOR IN BIOCHEMISTRY (6 COURSES)

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.301 Biochemistry
33.409 Biochemistry II - Nutritional Biochemistry/Metabolism

FOOD SCIENCE MAJOR

FOOD SCIENCE AND TECHNOLOGY CONCENTRATION (FST)

Department Requirements

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.151 Principles of Food Science
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.302 Biochemistry I-Structures, Mechanisms and Analysis
33.303 Physical Chemistry I
33.351 Food Engineering and Processing
33.405 Food Analysis
33.408 Food Chemistry
33.495 Food Industrial Practicum **or**
33.490 Directed Study in Food Science **or**
33.304 Physical Chemistry II
23.101 Biological Concepts (Gen.Ed. Goal 7)
23.272 Human Anatomy and Physiology I
23.273 Human Anatomy and Physiology II
23.307 Principles of Microbiology
23.411 Food Microbiology
34.374 Human Nutrition Science
43.208 Biostatistics **or**
43.117 Introduction to Statistics
43.219 Calculus I (Gen.Ed. Goal 2)
43.220 Calculus II
53.211 Principles of Physics I
53.212 Principles of Physics II

APPLIED FOOD SCIENCE CONCENTRATION (FSA)

Department Requirements

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.151 Principles of Food Science
33.207 Organic Chemistry I
33.208 Organic Chemistry II
33.301 Biochemistry
33.405 Food Analysis
33.408 Food Chemistry
33.351 Food Engineering and Processing **or**
23.411 Food Microbiology
23.101 Biological Concepts (Gen.Ed. Goal 7)
23.272 Human Anatomy and Physiology I
23.307 Principles of Microbiology

43.200 Precalculus **or**
43.219 Calculus I (Gen.Ed. Goal 2)
43.208 Biostatistics **or**
43.117 Introduction to Statistics
53.201 Introductory Physics

A minor in one of the following areas is required with the Applied Food Science concentration: biology, business, or nutrition. Other minors may be approved by the Department of Chemistry and Food Science.

MINOR IN FOOD SCIENCE (7 COURSES)

33.107 Principles of Chemistry
33.108 Principles of Chemistry and Quantitative Analysis
33.151 Principles of Food Science or
34.364 Experimental Study of Food
33.207 Organic Chemistry I
33.301 Biochemistry

Choose two (2) of the following:

33.351 Food Engineering and Processing
33.405 Food Analysis
33.408 Food Chemistry

CHEMISTRY COURSES APPROPRIATE FOR GENERAL EDUCATION (GEN. ED.)

Courses		**Goal**
33.101	Chemistry of Life	6
33.103	General Chemistry	6, Lab
33.107	Principles of Chemistry	6, Lab
33.108	Principles of Chemistry and Quantitative Analysis	6, Lab
33.131	Science - Environment and Health	6, Lab
33.151	Principles of Food Science	6

COURSE DESCRIPTIONS

33.101 The Chemistry of Life (Gen. Ed. Goal 6)
An exploration of the origin of life on a molecular basis; a familiarization with the basic chemistry of living organisms and their environment; an understanding of the laws that govern life; and a discussion on the fate of life as a consequence of drugs and man's chemical pollution of the earth's atmosphere, soil and water. Designed as a terminal non-laboratory course for the liberal arts non-science student.

33.103 General Chemistry (Gen. Ed. Goal 6, Lab)
A study of the fundamental chemical laws and theories, with laboratory, for students not planning to major in chemistry.

33.107 Principles of Chemistry (Gen. Ed. Goal 6, Lab)
A study of the fundamental principles of chemistry, with laboratory, for students planning to major in chemistry and others for whom the course is a departmental requirement.

33.108 Principles of Chemistry and Quantitative Analysis (Gen. Ed. Goal 6, Lab)
A continuation of Principles of Chemistry covering the fundamental principles of chemistry with major emphasis on the theory and techniques of quantitative analysis, including an introduction to instrumentation. **Laboratory**.
Prerequisite: 33.107 Principles of Chemistry **or** equivalent.

33.131 Science - Environment and Health (Gen. Ed. Goal 6, Lab)
An integrative **laboratory** science course to prepare non-science majors to make informed decisions relating to the environment, health, and technology. Central principles of physical, environmental, and biological chemistry are discussed, with application of these principles to current events. Assignments and laboratory sessions apply theoretical principles to everyday life.
Prerequisite: 43.123 College Algebra is recommended background.

33.151 Principles of Food Science (Gen. Ed. Goal 6)
A study of food systems as chemical entities. This course employs biological sciences, physical sciences, and engineering in the study of the nature of foods, causes of deterioration, and the principles underlying food processing. Emphasis is placed on food research in the twenty-first century.

33.201 Organic Chemistry
A one-semester course designed to provide a concise introduction to the fundamental and most important principles of organic chemistry. Compounds are discussed in terms of their structure, reactions, importance in nature and applications to allied fields. **Laboratory**.
Prerequisite: 33.103 General Chemistry.

33.207 Organic Chemistry I
An in-depth course which covers structure, properties, preparation and reactions of the principal classes of organic compounds. Emphasis is on reaction mechanisms, discussed in the context of transition state theory, and on the relationships between structure, properties and reactivity. Laboratory work, coordinated with lectures, introduces the standard techniques (distillation and reflux, crystallization and melting points, extraction, column and gas chromatography, IR and UV-VIS spectroscopy) used in synthesis, purification and identification of organic compounds, and illustrates some typical reactions of alkanes, alkenes and alcohols.
Prerequisite: 33.108 Principles of Chemistry and Quantitative Analysis.

33.208 Organic Chemistry II
Continuation of Organic Chemistry I. Topics include the use of organometallic reagents in synthesis, application of isotopes to mechanistic studies, kinetics and rate equations, chemistry of diverse types of aromatic compounds, enolization and related syntheses, nitrogen compounds, 1H and 13C NMR spectroscopy, orbital symmetry and pericyclic reactions. Laboratory work reinforces the concepts and techniques covered earlier, and also includes NMR, a kinetics vs. equilibrium control study, and rate and activation energy measurements.
Prerequisite: 33.207 Organic Chemistry I.

33.301 Biochemistry
A study of the physico-chemical aspects of biological activity; the chemistry of carbohydrates, lipids, nucleic acids, amino acids and proteins, kinetics and enzymes; bioenergetics; coenzymes; and intermediary metabolism of carbohydrates, fats and nitrogen-containing materials such as amino acids, proteins and related compounds, and photosynthesis. The underlying theme of this course is not merely a cataloging of the structure and metabolism of biological compounds, but rather is an understanding of the cell molecular logic of living organisms. **Laboratory**.
Prerequisite: 33.207 Organic Chemistry I and completion of college level mathematics requirement, preferably 43.123 College Algebra.

33.302 Biochemistry I-Structures, Mechanisms and Analysis
An overview of amino acid, peptide, carbohydrate, lipid, nucleotide and nucleic acid chemistry. Structural and functional properties of proteins, carbohydrates, lipids, biomembranes, plasma lipoproteins, and polynucleotides are surveyed in addition to enzyme kinetics and bioenergetic mechanisms plus introductory integrated metabolism. **Laboratory**.
Prerequisite: 33.208 Organic Chemistry II, 43.200 Precalculus or equivalent.

33.303-4 Physical Chemistry I and II
An introduction to the principles of physical chemistry. The topics treated include chemical thermodynamics, phase equilibria, solutions, the kinetic theory of gases, chemical kinetics, electrochemistry, spectroscopy and quantum chemistry. **Laboratory**.
Prerequisite: 53.211-2 Principles of Physics I and II and two (2) courses in calculus.

33.321 Instrumental Analysis
An introduction to the theory and application of common chemical instrumentation with associated laboratory. Basic electronics (voltage dividers, passive filters, simple op-amps, s/n enhancement), electrochemical methods (differential pulse polarography and stripping analysis), spectroscopic methods (UV-Vis, AA, Fl, NMR, Mass spec), chromatographic methods (GC, HPLC), and radiochemical methods (activation and dilution analysis).
Prerequisite: 33.207 Organic Chemistry I and 33.303 Physical Chemistry I.

33.351 Food Engineering and Processing
An integrated approach of food engineering principles and food processing techniques. Topics include thermodynamics, fluid flow and heat transfer, evaporation, refrigeration, psychrometry, drying, distillation and the essential food processing methods that ensure attainment of food product wholesomeness. **Laboratory**.
Prerequisite: Permission of instructor.

33.401 Inorganic Chemistry
An introduction to the theories of structure and bonding used in inorganic chemistry and a study of the descriptive chemistry of the elements and their representative compounds. Topics covered include atomic structure and trends in the periodic table, structure and bonding in crystalline lattices, valence bond and molecular orbital theories of covalent bonding, descriptive chemistry of the non-transition elements, properties of transition metals, and structure and bonding in transition metal complexes interpreted in terms of the valence bond, crystal field and molecular orbital theories. **Laboratory**.
Prerequisite: 33.303-4 Physical Chemistry I and II (33.304 Physical Chemistry II may be taken concurrently).

33.405 Food Analysis
A study of the fundamental principles of food analysis with the laboratory work including both the classical and the more recent sophisticated methods of analysis.
Prerequisite: 33.207 Organic Chemistry I, and either 33.301 Biochemistry or 33.302 Biochemistry I - Structures, Mechanisms and Analysis.

33.408 Food Chemistry
The chemistry of food constituents and the chemical and biological changes occurring in foods during storing and processing. The approach is from a cellular and molecular level.
Prerequisite: 33.301 Biochemistry **or** 33.302 Biochemistry I - Structures, Mechanisms and Analysis.

33.409 Biochemistry II-Nutritional Biochemistry/Metabolism
A detailed investigation of protein, carbohydrate, lipid, and nucleic acid metabolism in the total scheme of integrated metabolic systems. Direct and circumstantial relationships involving animal and human nutrition in normal and pathological health conditions are discussed wherever a dietary or nutritional component is involved. This course replaces 33.410 Advanced Biochemistry.
Prerequisite: 33.302 Biochemistry I - Structures, Mechanisms and Analysis.

33.411 Advanced Organic Chemistry - Reactions and Synthesis
A discussion of reactions widely used in organic synthesis in sufficient depth to allow for an understanding of the selectivity of the reaction and its stereochemical outcome. The use of protective groups and synthetic equivalents is illustrated in multistep synthesis.
Prerequisite: 33.208 Organic Chemistry II.

33.412 Advanced Organic Chemistry - Mechanism and Structure
A focus on theoretical aspects of organic chemistry, and experimental evidence on which the theories are built. The topics include aromaticity, orbital symmetry, HMO theory and calculations; linear free-energy relationships, kinetics, and isotope effects; acids and bases, solutions, and ion pairs; reactive intermediates - carbocations, carbanions and free radicals; electrocyclic reactions, cycloadditions, and sigmatropic shifts; photochemistry.

Prerequisite: 33.208 Organic Chemistry II, 33.303-4 Physical Chemistry I and II (33.304 Physical Chemistry II may be taken concurrently).

33.414 Advanced Physical Chemistry
An introduction to statistical thermodynamics. The Maxwell-Boltzmann statistics as well as quantum statistics are treated. The relationship between partition functions and thermodynamic properties is developed. Gaseous, liquid and solid state systems are discussed in light of the concepts of statistical thermodynamics.
Prerequisite: 33.303-4 Physical Chemistry I and II.

33.416 Advanced Inorganic Chemistry
An application of the theories of bonding and structure studied in Inorganic Chemistry to inorganic systems of both classic and current interest. To complement the study of these model systems, some descriptive chemistry of the less common but important elements is included. In addition, the structures and bonding theories of metals, semiconductors, and nonstoichiometric compounds are introduced. Finally, students are introduced to the study of symmetry in chemistry from the point of view of group theory.
Prerequisite: 33.401 Inorganic Chemistry.

33.421 Advanced Analytical Chemistry
A discussion of topics selected from recent literature in chromatography, ion selective electrodes and sensors, atomic spectroscopy, surface analysis, Fourier transform methods, computerized data acquisition, data treatment, and **laboratory** automation.
Prerequisite: 33.208 Organic Chemistry II, 33.304 Physical Chemistry II, and 33.321 Instrumental Analysis.

33.490 Directed Study in Food Science
An original problem to be selected and researched under the direction of a faculty member. A written presentation of the research findings is required.
Prerequisite: Permission of the instructor.

33.491 Directed Study in Chemistry
An in-depth study of a selected advanced chemistry topic or topics under the direction of a chemistry faculty member. The grade is based on a written report of the study and/or oral exam.

33.495 Food Industrial Practicum
Enhancement of student's practical knowledge of food science by participating in projects sponsored by industrial and/or governmental agencies.
Prerequisite: Permission of instructor.

33.497-8 Chemical Research I and II
An application of the Scientific Method to an original research problem. During the first semester formal course work includes the Scientific Method, the choice of a research problem, the chemical literature, advanced safety issues, the interpretation of data, and the reporting of results. Students initiate a research project with a faculty member and make significant progress on the project. The research project will then be completed in the second semester, resulting in a formal written report and seminar presentation.
Prerequisite: Permission of the instructor.