Cell Biology/Biochemistry (BICH)

Developed jointly by the biology and chemistry departments, the major in cell biology and biochemistry at Bucknell is interdisciplinary in nature. The Bachelor of Science major is designed for students who are interested in understanding living organisms at the cellular and molecular level. This course of study will provide strong foundations in both biology and chemistry and will offer the student both the intellectual and the laboratory skills to grapple with questions at the interface of these two disciplines. In addition to a rigorous scientific education, this program enables students to gain a strong background in the liberal arts and to think critically about the impact of biotechnology on social and ethical issues.

The major in cell biology/biochemistry will focus on subdisciplines within biology and chemistry such as immunology, genetic engineering, nucleic acids, biomembrane function, cell biology of cancer, and enzymology. This program strongly emphasizes independent student research, including both seminar programs and hands-on research. A major in cell biology/biochemistry offers students an excellent preparation for careers in biotechnology, biomedical technology, medicine, pharmacology and bioengineering. It also is an excellent foundation for students preparing for entrance into Ph.D. programs in cell and molecular biology or biochemistry or Ph.D./M.D. programs in medically related fields.

Cell Biology/Biochemistry Major

The **major** requires:

BIOL 205	Introduction to Molecules and Cells [1]	1
BIOL 206	Organismal Biology [1,2]	1
BIOL 207	Genetics	1
BIOL 327	Molecular Biology	1
BIOL 352	Cell Biology	1
CHEM 211	Organic Chemistry I	1
CHEM 212	Organic Chemistry II	1
CHEM 221	Inorganic Chemistry I	1
CHEM 231	Analytical Chemistry	1
CHEM 340	Biological Physical Chemistry	1
or CHEM 341	Physical Chemistry I	
CHEM 351	Biochemistry I	1
BIOL 340/CHEM 358	Biochemical Methods [1]	1
PHYS 211	Classical and Modern Physics	1
PHYS 212	Classical and Modern Physics	1
MATH 201	Calculus I	1
MATH 202	Calculus II	1
Select three of the following: [3]		3
BIOL 302	Microbiology	
BIOL 304	Biology of Cancer	
BIOL 316	Plant Growth and Development	
BIOL 318	Principles of Physiology	
BIOL 322	Physiological Mechanisms	
BIOL 323	Mammalian Histology	
BIOL 324	Neurophysiology	
BIOL 326	Cytogenetics	
BIOL 328	Endocrinology	
BIOL 337	Biology of Aging	
BIOL 339	Developmental Biology	
BIOL 347	Virology	
BIOL 348	Immunology	
BIOL 365	Introduction to Microscopy	
BIOL 399	Undergraduate Research [4]	
CHEM 313	Synthetic Organic Chemistry	
CHEM 314	Mechanistic Organic Chemistry	

CHEM 317	Special Topics in Organic Chemistry
CHEM 322	Inorganic Chemistry II
CHEM 332	Analytical Chemistry II
CHEM 342	Physical Chemistry II
CHEM 352	Biochemistry II
CHEM 360	Advanced Environmental Chemistry
CHEM 375	Undergraduate Research [4]
CHEM 376	Undergraduate Research [4]

1 Contributes to satisfying the writing in the major and information literacy requirements.

2 Satisfies the formal presentation requirement.

3 At least one of these biology or chemistry electives must be a laboratory course.

4 One full credit of a research course may be counted as an elective toward the major.

The Culminating Experience requirement will be fulfilled by cell biology/biochemistry students after completing one of the following:

- Enrolling in a 300-level laboratory course in biology during their last three semesters. These classes will utilize inquiry-based learning and require students to demonstrate writing, information literacy and speaking at a level that is appropriate for a graduating cell biology/biochemistry major.
- Registering for independent research in either biology (BIOL 399 Undergraduate Research) or chemistry (CHEM 375 Undergraduate Research or CHEM 376 Undergraduate Research)
- Completing an Honors thesis

The recommended sequence for the Bachelor of Science major is as follows:

First Year

First Semester	Credits	Second Semester	Credits
BIOL 205	1	BIOL 206	1
CHEM 211	1	CHEM 212	1
MATH 201	1	MATH 202	1
	3		**3**

Sophomore

First Semester	Credits	Second Semester	Credits
BIOL 207	1	BIOL 327	1
CHEM 221	1	CHEM 231	1
	2		**2**

Junior

First Semester	Credits	Second Semester	Credits
BIOL 352	1	BIOL 340 or CHEM 358	1
CHEM 351	1	PHYS 212	1
PHYS 211	1	Elective in biology or chemistry	
	3		**2**

Senior

First Semester	Credits	Second Semester	Credits
Select one of the following:	1	Select one of the following:	1
CHEM 341		CHEM 340	
Elective in biology or chemistry		Elective in biology or chemistry	
		Elective in biology or chemistry	1
	1		**2**

Total Credits: 18

Placeholder for departmental learning goals.

Faculty

Director: Charles H. Clapp

Coordinating Committee: Mitchell I. Chernin, Charles H. Clapp, Kenneth A. Field, Matthew B. Heintzelman, Elizabeth C. Marin, Kathleen C. Page, Marie C. Pizzorno, David Rovnyak, James S. Swan

Other Participating Faculty: Dee Ann Casteel, Julie A. Gates, Elizabeth C. Marin, Leocadia V. Paliulis, Emily Stowe, Timothy G. Strein, Brian W. Williams

Biology Courses

BIOL 111. Controversies in Biology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:1
Introduction for the non-science major. Background on molecules, cells, and genetics. Required recitation will include discussions about current advances and controversies in biology. Not for pre-health students. Will not count toward the biology major. Students who take BIOL 111 may not take BIOL 121.

BIOL 121. Biology for Non-majors. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Introductory course primarily for the non-biology major. Focuses on life at the cellular and biochemical levels, genetics, and biotechnology. This course is not appropriate preparation for the majority of pre-health graduate programs. Please consult with the Pre-health Adviser for more information.

BIOL 122. Biology for Non-majors. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Introductory course primarily for the non-biology major. Topics covered include principles of ecology, evolution, animal diversity, behavior, and structure, and function. It is not necessary to take BIOL 121 prior to taking BIOL 122. This course is not appropriate preparation for the majority of pre-health graduate programs. Please consult with the Pre-health Adviser for more information.

BIOL 130. Health and Disease. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A biology course, for non-majors only, that explores the basic biological principles underlying normal health and the most common diseases of humans.

BIOL 137. Biology of Aging and Longevity. 1 Credit.
Offered Summer Session Only; Lecture hours:6
This course will explore questions in the biology of aging from a physiological, genetic, and evolutionary framework.

BIOL 150. Plants, People, and the Environment. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3
The diversity and evolution of plants, fungi, and related organisms with special emphasis on flowering plants; their importance for food, fiber, medicine, and psychoactive compounds; origins of agriculture; domestication of plants; and the role of plants in the environment.

BIOL 1NT. Biology Non-traditional Study. .5-2 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies
Nontraditional study in Biology. Prerequisite: permission of the instructor.

BIOL 205. Introduction to Molecules and Cells. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:4
An introductory course which focuses on the molecular biology of cells. Basic biochemical processes, cellular and subcellular structure and function are emphasized. First core course.

BIOL 206. Organismal Biology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:4; May require dissection or live animal experimentation
An introductory course for biology majors emphasizing organisms as dynamic systems by integrating structure with function. Laboratories introduces scientific method and collaborative learning. Second core course. BIOL 205 is strongly recommended as a prerequisite.

BIOL 207. Genetics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:1
A comprehensive survey of genetic mechanisms and methodologies, including classical genetics, recombinational analysis in bacteria, fungi, and higher eukaryotes, molecular genetics and populational and quantitative genetics. Third core course. Prerequisite: BIOL 205.

BIOL 208. Principles of Ecology and Evolution. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
Introduction to systematic biology, evolutionary theory, physiological ecology, behavioral ecology, population and community ecology, and ecosystem structure and function. Fourth core course. BIOL 206 and BIOL 207 strongly recommended as prerequisites.

BIOL 220. Human Anatomy. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
A course that focuses on the anatomy of and relationship between human muscles, bones, and organs. Lab involves dissection, with the cat as the primary specimen. Does not count towards the biology major. Prerequisite: permission of the instructor.

BIOL 221. Human Physiology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
A course that focuses on the functions of and interactions between human organ systems. Does not count towards the biology major. Prerequisite: permission of the instructor.

BIOL 231. Phage Hunters - Part I. .5 Credits.
Offered Fall Semester Only; Lecture hours:Varies,Other:4
Students in this investigative laboratory course will isolate viruses that infect bacteria (bacteriophages) from soil samples and characterize the genome using molecular genetics techniques. Prerequisite: BIOL 205 and permission of the instructor. Corequisite: BIOL 207.

BIOL 232. Phage Hunters - Part II. .5 Credits.
Offered Spring Semester Only; Lecture hours:Varies,Other:4
Continuation of BIOL 231. Students will learn the theory and application of bioinformatics and genomics to analyze the genome sequence of a bacteriophage isolated from soil samples. Prerequisites: BIOL 231 and permission of the instructor.

BIOL 235. Introduction to Microbiology. 1 Credit.
Offered Alternating Summers; Lecture hours:6,Other:6
An introduction to microbiology for non-science majors. Course will focus on the interaction between humans and microbes, not limited to disease.

BIOL 245. Tropical Marine Biology. 1 Credit.
Offered Summer Session Only; Lecture hours:10,Other:18
A field course in marine biology of coral reefs in the Virgin Islands for non-science majors. Prerequisite: permission of the instructor. Prerequisite: permission of the instructor.

BIOL 266. Animal Behavior. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
A survey of important theories, issues, and empirical techniques in the interdisciplinary field of animal behavior emphasizing both proximate and ultimate mechanisms and explanations for behavior. Crosslisted as ANBE 266 and PSYC 266.

BIOL 302. Microbiology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:4
Ultra-structure, behavior, metabolism, molecular biology, and development of micro-organisms. Roles in disease and food production. Laboratory will emphasize cultivation and identification. Prerequisites: BIOL 205 and BIOL 207, and permission of the instructor.

BIOL 304. Biology of Cancer. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
The study of the molecular and cellular mechanisms that create cancer. Prerequisites: BIOL 205, BIOL 207, and permission of the instructor.

BIOL 309. Wildlife and Emerging Diseases. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3
Biology of wildlife diseases, especially zoonoses (infections that jump to humans). Course will integrate popular and scientific sources. Prerequisites: BIOL 206 and permission of the instructor.

BIOL 312. Comparative Vertebrate Anatomy. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Gross morphology with emphasis on functional and evolutionary modifications of animal structure. Gross dissection and techniques used in morphology. Prerequisites: BIOL 122 or BIOL 206 and permission of the instructor.

BIOL 313. Mammalogy. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Biology of mammals, including evolution, classification, biodiversity, behavior, anatomy, physiology, ecology, and conservation. Lab will include specimen identification, preparation, and field studies. Prerequisite: permission of the instructor.

BIOL 314. Amphibian Biology and Conservation. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3
The biology of amphibians, including classification, physiology, reproduction, ecology, evolution, and conservation. Laboratory section will include identification of amphibians and field work to identify conservation issues surrounding local amphibian populations. Prerequisites: BIOL 206, BIOL 208 and permission of the instructor. Crosslisted as ANBE 314.

BIOL 316. Plant Growth and Development. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3,Other:3
The physiological and molecular bases of growth and development at the organ, tissue, and cellular levels. Effects of environmental stimuli and hormones on gene expression and the resultant changes at higher levels of organization. Prerequisite: BIOL 205, BIOL 206, and permission of the instructor.

BIOL 318. Principles of Physiology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:3
Emphasizes the breadth of physiology and explores physiological principles of animals from a cellular, organismal, medical, and ecological framework. Laboratory focuses on experimental design and independent research. Prerequisites: BIOL 205, BIOL 206 and permission of the instructor.

BIOL 319. Seminar. 1 Credit.
Offered Either Fall or Spring; Lecture hours:Varies,Other:3; Repeatable
Topics vary.

BIOL 320. Seminar. 1 Credit.
Offered Either Fall or Spring; Lecture hours:Varies,Other:3; Repeatable
Topics vary.

BIOL 321. Behavioral Ecology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
The consideration of behavioral adaptations to various ecological situations. Topics include habitat choice, foraging behavior, defenses against predation, mate choice, and brood care. Prerequisites: BIOL 208 and permission of the instructor.

BIOL 322. Physiological Mechanisms. 1 Credit.
Offered Alternating Spring Semester; Lecture hours:3
Integration of cell and organ physiology; emphasis on protein, ion transport, nerve and muscle physiology, cardiovascular, renal, and respiratory systems. Prerequisites: BIOL 205 and permission of the instructor.

BIOL 323. Mammalian Histology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
A detailed study of the microscopic architecture and associated physiology of mammalian cells, tissues and organ systems. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor.

BIOL 324. Neurophysiology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A study of neural signaling via stimulus-response, with an emphasis on cellular integration. Sensory-motor as well as more complex brain systems will be explored. Prerequisites: BIOL 205 and BIOL 206 or NEUR 100 and permission of the instructor.

BIOL 326. Cytogenetics. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
Study of chromosome structure, organization, aberrations, and behavior. Multiple eukaryotic systems will be considered with links to human disease. Perquisites: BIOL 205 and BIOL 207 and permission of the instructor.

BIOL 327. Molecular Biology. 1 Credit.
Offered Both Fall and Spring,Offered Spring Semester Only; Lecture hours:3,Other:3
Synthesis of DNA, RNA, and protein, and the regulation of these processes in both prokaryotic and eukaryotic cells; laboratory experience in the manipulation and analysis of genes. Prerequisites: BIOL 205 and BIOL 207 and permission of the instructor.

BIOL 328. Endocrinology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:2
Regulation and function of hormones and their receptors from molecular to organismal levels. Role of hormones in development, physiology, and behavior; endocrine disease. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor.

BIOL 330. Plant Systematics. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:4
Exploration of the diversity of plant life on Earth through lectures, labs, and field trips; includes biogeography, natural history, evolutionary relationships, ethnobotanical uses, and identification. Prerequisite: BIOL 206 or permission of the instructor.

BIOL 331. Functional Genomics. 1 Credit.
Offered Occasionally; Lecture hours:3,Other:2
A computer research-based course in which students study the structure, content, expression and evolution of genomes. Prerequisites: BIOL 207 and permission of the instructor.

BIOL 332. Developmental Neurobiology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:1
Primary literature-based senior seminar on topics in developmental neurobiology. Prerequisites: BIOL 205, BIOL 207, and either BIOL 206 or NEUR 100, junior or senior status, and permission of the instructor. Crosslisted as NEUR 332.

BIOL 334. Limnology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3
The physical, chemical, and biological characteristics of fresh-water communities are studied. Prerequisites: BIOL 208 and permission of the instructor.

BIOL 336. Anatomy and Microscopy of Plants. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
Introduction to the internal structure of plants, including subcellular anatomy, plant cell types, tissue types, and the diversity of these types across the plant kingdom. Significant experience with multiple forms of microscopy involved. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor.

BIOL 337. Biology of Aging. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
This course will explore questions in the biology of aging from a physiological, genetic, and evolutionary framework, with an emphasis on critical reading of primary literature. Prerequisites: BIOL 206 or NEUR 100 and permission of the instructor.

BIOL 339. Developmental Biology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
This course provides an introduction to early animal development with emphasis on the molecular, cellular and genetic mechanisms that drive the formation of the embryo. Prerequisites: BIOL 205 and BIOL 206 or NEUR 100 and permission of the instructor.

BIOL 340. Biochemical Methods. 1 Credit.
Offered Spring Semester Only; Lecture hours:2,Other:6
A course in laboratory techniques including cell fractionation and analysis of proteins and nucleic acids. Spectrophotometry, chromatography, centrifugation, electrophoresis, and methods of molecular cloning are emphasized. Prerequisites: BIOL 205 and CHEM 351 and permission of the instructor. Crosslisted as CHEM 358.

BIOL 341. Organic Evolution. 1 Credit.
Offered Alternating Spring Semester; Lecture hours:3,Other:3
The principles and mechanisms of evolution in plants and animals, covering population phenomena, speciation, life history strategies, adaptation, systematics, and biogeography. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as ANBE 341.

BIOL 342. Neuroethology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A course that integrates neurobiology and behavior in natural contexts. Emphasis on signal detection, recognition, discrimination, localization, orientation, and the control of complex acts. Neuronal and hormonal mechanisms, ontogeny and evolution of behavior will be considered. Prerequisites: BIOL 206 or NEUR 100 and BIOL 208 and permission of the instructor. Crosslisted as ANBE 342.

BIOL 347. Virology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:2
The study of virus structure, genome organization, replication and host-interactions. Emphasis will be on animal and bacterial viruses. Prerequisites: BIOL 205, BIOL 207, and permission of the instructor.

BIOL 348. Immunology. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Development and function of the immune system in animals. The immune response in health and disease. Techniques in immunology. Prerequisites: BIOL 205 and BIOL 206 or NEUR 100 and permission of the instructor.

BIOL 351. Field Botany. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:1
Outdoor field experience in plant diversity and ecology. Excursions to natural areas focused on identification, community dynamics, and ecological interactions/adaptations. Prerequisites: BIOL 208 and permission of the instructor.

BIOL 352. Cell Biology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3
Covers biomembranes, cell growth patterns, cell signaling, the cytoskeleton, cell organelles, and microscopic techniques. Laboratory includes experience with cell culture. Prerequisites: BIOL 205 and permission of the instructor.

BIOL 353. Ecosystem Ecology. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3,Other:1
Interactions between organisms and physical and chemical environment including nutrient cycling and energy flow, biogeochemistry, and temporal and spatial dynamics of ecosystems. Prerequisites: BIOL 208, junior or senior status, and permission of the instructor.

BIOL 354. Tropical Ecology. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Introduction to tropical ecology including life history strategies of vertebrates and invertebrates, biodiversity management and conservation. Emphasis on class and individual projects, data collection, and journal keeping. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as ANBE 354.

BIOL 355. Social Insects. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:2
Evolution and genetics of social behavior, caste, communication in foraging and colony defense, queen and worker control over reproduction, social homeostasis and population dynamics. Occasionally may be taught as a laboratory science. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as ANBE 355. Juniors and seniors only.

BIOL 357. Ornithology. 1 Credit.
Offered Occasionally; Lecture hours:3,Other:3
The biology of birds, including evolution, behavior, anatomy, physiology, ecology, and conservation; lab trips focus on identification of birds in the field. Prerequisites: BIOL 206, BIOL 208 and permission of the instructor. Crosslisted as ANBE 357.

BIOL 358. Invertebrate Zoology. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3,Other:3
A survey of the invertebrate phyla covering phylogenetic relationships, functional morphology, ecology, life histories, symbiosis, ontogeny, and behavior. Includes hands-on study of organisms in lab and field. Prerequisites: BIOL 206, BIOL 208, and permission of the instructor.

BIOL 359. General Entomology. 1 Credit.
Offered Alternating Fall Semester; Lecture hours:3,Other:3
The biology of insects and their kin: anatomy, physiology, ecology, behavior, development, evolution, systematics, and diversity. Prerequisites: BIOL 206, BIOL 208, and permission of the instructor.

BIOL 361. Systematic Biology. 1 Credit.
Offered Occasionally; Lecture hours:3
Seminar in systematics, the study of the classification, diversity, and evolutionary relationships of all life. Emphasis placed on molecular data and the importance of systematics to all fields of biology. Prerequisites: BIOL 207, BIOL 208 and permission of the instructor.

BIOL 365. Introduction to Microscopy. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
This course is designed as an overview of light and electron microscopy, with emphasis placed on the use of instrumentation. Prerequisites: BIOL 352 and permission of the instructor.

BIOL 370. Primate Behavior and Ecology. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation
Introduction to research on prosimians, monkeys, and apes including diversity, social evolution, sexual selection, reproduction, social behavior, and cognitive abilities. Prerequisites: BIOL 122 or BIOL 208 or BIOL 266 and permission of the instructor. Crosslisted as ANBE 370 and PSYC 370.

BIOL 399. Undergraduate Research. .5-2 Credits.
Offered Fall, Spring or Summer; Lecture hours:Varies,Other:Varies; Repeatable; May require dissection or live animal experimentation
Undergraduate research. Prerequisite: permission of the instructor.

Chemistry Courses

CHEM 105. Introduction to Chemistry. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:3
A terminal elementary course covering in-depth selected topics, which may vary from year to year. Satisfies science requirement for Bachelor of Arts students not majoring in science or engineering. Not open to students who have taken CHEM 160. Prerequisite: seniors by permission only.

CHEM 160. Introduction to Environmental Chemistry. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:3
One semester terminal course in chemistry. Basic chemical concepts as they relate to chemical behavior, toxicity, and effects in the environment. Case studies are used to illustrate concepts. Satisfies laboratory science requirement for Bachelor of Arts students not majoring in science or engineering. Laboratory will emphasize techniques used for environmental analysis. Not open to students who have taken CHEM 201, CHEM 202, or CHEM 211. Prerequisite: seniors by permission only.

CHEM 201. General Chemistry. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3,Other:5
Fundamental principles in inorganic chemistry. Atomic structure, bonding, equilibrium, kinetics, etc. Laboratory experiments are both qualitative and quantitative. CHEM 201 is a prerequisite for CHEM 202. Credit not normally given for both CHEM 201 and CHEM 221 nor is credit normally given for CHEM 202 and CHEM 221 or CHEM 231.

CHEM 202. General Chemistry. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3,Other:4
Fundamental principles in inorganic chemistry. Atomic structure, bonding, equilibrium, kinetics, etc. Laboratory experiments are both qualitative and quantitative. CHEM 201 is a prerequisite for CHEM 202. Credit not normally given for both CHEM 201 and CHEM 221 nor is credit normally given for CHEM 202 and CHEM 221 or CHEM 231.

CHEM 211. Organic Chemistry I. 1 Credit.
Offered Fall Semester Only; Lecture hours:4,Other:5
First-year, first-semester course for students majoring in chemistry, biochemistry, and biology. Bonding and structure in organic compounds, resonance, organic acid/base reactions, basic nomenclature, conformational analysis, stereochemistry, properties and reactions of functional groups. Prerequisite: high school chemistry or equivalent.

CHEM 212. Organic Chemistry II. 1 Credit.
Offered Spring Semester Only; Lecture hours:4,Other:5
A continuation of CHEM 211 with focus on properties and reactions of functional groups, synthesis, and spectroscopic analysis. Prerequisite: CHEM 211.

CHEM 221. Inorganic Chemistry I. 1 Credit.
Offered Fall Semester Only; Lecture hours:2,Other:4
Introduction to structures, bonding theories, and reactivity of inorganic systems. Introductory thermodynamics and kinetics. Emphasizes hands-on, experiential learning in workshops and laboratory. Prerequisite: CHEM 212 or permission of the instructor.

CHEM 222. Accelerated General Chemistry: Inorganic. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:5
Atomic structure and introductory quantum mechanics. Molecular structure and theories of bonding. Introductory thermodynamics and kinetics. Introduction to coordination chemistry. Laboratory: introduction to quantitative techniques. Prerequisite: Chemical Engineering students. All others by permission of the instructor.

CHEM 231. Analytical Chemistry. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:5
Chemical equilibrium and modern analysis with an emphasis on acid-base systems, solubility, metal ion determinations, electroanalytical chemistry, spectrophotometry, and separation methods. Prerequisite: CHEM 221 or CHEM 222.

CHEM 2NT. Chemistry Non-traditional Study. 1-2 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:Varies
Nontraditional study in chemistry. Prerequisite: permission of the instructor.

CHEM 304. X-ray Crystallography. .5-1 Credits.
Offered Either Fall or Spring; Lecture hours:Varies,Other:Varies
Independent Study. Symmetry (point, plane, and space groups) diffraction (reciprocal space, precession photographs, automated data collection)and structural solution (Patterson Maps, Electron Density Maps, Refinement). Prerequisite: permission of the instructor.

CHEM 313. Synthetic Organic Chemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Modern synthetic organic chemistry, with examples involving complex natural products. Application of organic mechanism, synthetic strategy, and advanced transformations to total synthesis. Prerequisite: CHEM 212.

CHEM 314. Mechanistic Organic Chemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:4,Other:2
Thermal and kinetic aspects of organic reactions are discussed along with the effect of substituents, solvents, and stereochemistry on reaction pathways. Qualitative molecular orbital theory of organic compounds is covered in depth. Weekly problem sessions are held. Prerequisites: CHEM 211 and CHEM 212.

CHEM 317. Special Topics in Organic Chemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:4; Repeatable
Available by independent study. Prerequisites: CHEM 212 and permission of the instructor.

CHEM 322. Inorganic Chemistry II. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:4
Survey course in modern inorganic chemistry covering transition metal, coordination, organometallic, and bioinorganic chemistry. Laboratory will consist of synthetic and physical measurements as well as the manipulation of air sensitive materials. Prerequisite: CHEM 231.

CHEM 327. Special Topics in Inorganic Chemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:4; Repeatable
Topics vary. Available by independent study. Prerequisite: CHEM 221.

CHEM 332. Analytical Chemistry II. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:4
Theory and practice of techniques of instrumental analysis including spectrophotometry, fluorescence, mass spectrometry, atomic absorption, chromatography, capillary electrophoresis, and dynamic electrochemistry. Prerequisite: CHEM 231.

CHEM 337. Special Topics in Analytical Chemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:4
Available by independent study. Prerequisite: CHEM 231 and permission of the instructor.

CHEM 340. Biological Physical Chemistry. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:6
Introduction to physical chemistry for life science students, with emphasis on thermodynamics, hydrodynamics and spectroscopy. Not open to B.S. chemistry majors. Prerequisites: CHEM 231, MATH 201, and PHYS 211. MATH 202 and PHYS 212 are recommended.

CHEM 341. Physical Chemistry I. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:5
Introductory physical chemistry with emphasis on thermodynamics, kinetics and electrochemistry. Prerequisites: CHEM 231, MATH 211, and PHYS 212. Not open to engineering majors.

CHEM 342. Physical Chemistry II. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Other:5
Introductory physical chemistry with emphasis on quantum mechanics, structure and bonding, molecular spectroscopy and statistical mechanics. The customized laboratory experience will emphasize applications of spectroscopy and computational methods. Prerequisite: CHEM 341.

CHEM 343. Physical Chemistry for Engineers. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:1
Introductory physical chemistry for engineers, with emphasis on thermodynamics, chemical kinetics and electrochemistry. Prerequisites: CHEM 231, MATH 211, PHYS 211. Only open to engineering majors.

CHEM 347. Special Topics in Physical Chemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:4
Available by independent study. Prerequisites: CHEM 231 and permission of the instructor.

CHEM 351. Biochemistry I. 1 Credit.
Offered Fall Semester Only; Lecture hours:4,Other:1
Introduction to biological chemistry with emphasis on the structure and function of proteins, lipids, carbohydrates and nucleic acids, kinetics and mechanisms of enzymes, bioenergetics, and metabolism. Prerequisites: CHEM 212 and either CHEM 231 or CHEM 202.

CHEM 352. Biochemistry II. 1 Credit.
Offered Spring Semester Only; Lecture hours:4,Other:1
Advanced topics in protein structure and function, protein folding, enzyme mechanisms, electron transport and free-energy coupling mechanisms, biosynthesis, metabolic regulation, and supramolecular assemblies. Prerequisite: CHEM 351 or permission of the instructor.

CHEM 357. Special Topics In Biochemistry. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3,Other:1
Structure/function relationships and dynamics of biomolecules. Prerequisite: permission of the instructor.

CHEM 358. Biochemical Methods. 1 Credit.
Offered Spring Semester Only; Lecture hours:2,Other:6
A course in laboratory techniques including cell fractionation, protein, and nucleic acid analysis. Spectrophotometry, chromatography, centrifugation, electrophoresis, and mass spectrometry are emphasized. Prerequisites: BIOL 205 and CHEM 351 and permission of the instructor. Crosslisted as BIOL 340.

CHEM 360. Advanced Environmental Chemistry. 1 Credit.
Offered Fall Semester Only; Lecture hours:4
Chemistry of the atmosphere, hydrosphere, and lithosphere. Natural processes and anthropogenic effects will be discussed. Prerequisite: CHEM 231 or permission of the instructor.

CHEM 371. Senior Seminar. .25 Credits.
Offered Both Fall and Spring; Lecture hours:1; Repeatable
Formal oral presentations on current research will be given by students, faculty and visiting scientists. Prerequisites: participation in an approved research project or independent study for seniors or second term juniors only.

CHEM 375. Undergraduate Research. .5-2 Credits.
Offered Both Fall and Spring; Lecture hours:Varies,Other:Varies; Repeatable
Original investigations in analytical, biological, organic, physical, environmental or inorganic chemistry.

CHEM 376. Undergraduate Research. .5-2 Credits.
Offered Both Fall and Spring; Lecture hours:Varies,Other:Varies; Repeatable
Original investigations in analytical, biological, organic, physical, environmental or inorganic chemistry.

CHEM 385. Seminar. .5 Credits.
Offered Both Fall and Spring; Lecture hours:2; Repeatable
Topics vary.

CHEM 386. Seminar. .5 Credits.
Offered Both Fall and Spring; Lecture hours:2; Repeatable
Topics vary.