List of Approved Advanced Electives for the Biochemistry Degree*:

Pay careful attention to prerequisites when choosing Advanced Electives.

Chemistry Courses:

CH 410. Application of Quantum Chemistry. 4 Credits. This course provides and overview of contemporary computational chemistry techniques used to model both single molecule and extended solids. Computations will be conducted on the new University of Oregon super computer, Talapas.

CH 410 Cellular Biochemistry. 4 credits. Given the complexity of cellular systems, scientists face challenges trying to visualize, quantify, and interpret the input-output relationships of individual and functionally redundant signaling pathways. In this course, we will discuss the major technological advances over the past 30 years that have contributed to scientific discovery at the interface between cell biology and biochemistry. Emphasis will be placed on defining the relationships between protein structure, function, and emergent properties of complex biological systems. This course is designed to teach students how to read, interpret, and discuss primary scientific research articles in biochemistry and cell biology.

CH 410. Design Principles of Dynamic Biological Systems. 4 Credits. In this course, we will discuss major technological advances over the past 30 years that accelerated scientific discovery at the interface between cell biology and biochemistry. Emphasis will be placed on defining the relationships between protein structure, function, and emergent properties in complex biological systems. Pre req CH 461; MATH 253.

CH 410. Science/Policy Interface. 4 Credits. This interdisciplinary (PHYS/CH) course has been developed around the use of science and scientific principles to produce better public policy outcomes on real world issues such as climate change, resource management, energy policy, environmental pollution, medical ethics, etc. Strong focus on improving skills for effectively communicating science to the policy world.

CH 410 Scientific Computing. 4 Credits. Programming skills are increasingly integral to all aspects of biochemical research. Programming competency enables new science because a researcher is not limited to "canned" analyses and approaches. Rather, a scientific programmer can flexibly learn, apply and tweak existing software as needed to answer scientific questions. In this course, students will learn how to think like a programmer when approaching real problems in biochemistry. For this, we will exclusively use the powerful and extensible Python programming language.

CH 410. Single-Molecule Methods. 4 Credits. In this course, students will learn about a variety of approaches used to interrogate single molecules, including techniques based on fluorescence, force, and current, and methods that utilize single molecules as raw materials for devices. We will discuss the theory behind these techniques as well as practical considerations for applying them hands-on. In addition, we will discuss specific studies that utilized single-molecule methods to probe systems ranging from model systems designed to investigate fundamental physical processes, to complex and dynamic biological machines. By studying both the fundamentals and applications of single-molecule methods, students will gain the ability to determine when such methods may be of use in their own research.

CH 413. Physical Chemistry. 4 Credits. Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to quantum chemistry. Prereq: two years of college chemistry (except for physics majors), PHYS 201, 202, 203; MATH 253; MATH 256, 281, 282 strongly recommended.

CH 417. Physical Chemistry Laboratory. 4 Credits. Experiments in thermodynamics, modern electronic measurements, computer modeling, and data reduction. Pre or coreq: CH 411.

CH 418. Physical Chemistry Laboratory. 4 Credits. Experiments in statistical mechanics, chemical kinetics, plasma chemistry, and mass spectrometry. Prerequisite CH 417; Pre or coreq: CH 412.

CH 419. Physical Chemistry Laboratory. 4 Credits. Experiments molecular spectroscopy, quantum chemistry, and laser-excited chemical and physical processes to illustrate theoretical principles. Prereq: CH 417; pre or coreq: CH 413.

CH 420. Physical Organic Chemistry I. 4 Credits. Modern physical organic chemistry including chemical bonding, acid-base chemistry, thermochemistry, noncovalent interactions, and introduction to computational chemistry. Sequence with CH 421/521. Prereq: CH 336 or CH 341.

CH 421. Physical Organic Chemistry II. 4 Credits. Modern physical organic chemistry including tools to study reaction mechanisms, kinetic analysis, isotope effects, and qualitative molecular orbital theory. Sequence with CH 420/520. Prereq: CH 420/520.

CH 429. Instrumental Analysis. 5 Credits. Use of instrumental methods for quantitative determinations of unknown chemical samples. Prereq: CH 417.

CH 431. Inorganic Chemistry. 4 Credits. Introduction to group theory for molecular symmetry; syntheses, structures, reactions, and reaction mechanisms of coordination complexes and organometallic complexes.

CH 432. Inorganic Chemistry. 4 Credits. Bioinorganic chemistry: metals in biological systems; coordination chemistry, reactions, spectroscopy, metalloclusters, and synthetic modeling. Prereq: CH 431.

CH 433. Inorganic Chemistry. 4 Credits. Solid-state inorganic chemistry: solid-state structure and its determination; the electrical, magnetic, and mechanical properties of materials and their physical description. Prereq: CH 431.

CH 441. Quantum Chemistry. 4 Credits. The principles of time-independent quantum mechanics and their application to model atomic and molecular systems. Prereq: CH 413 or equivalent.

CH 442. Quantum Chemistry and Spectroscopy. 4 Credits. Molecular structure theory, perturbation theory, time-dependent quantum mechanics, theory of spectra, selection rules. Prereq: CH 441 or equivalent.

CH 443. Quantum Chemistry and Spectroscopy. 4 Credits. Experimental spectra of atomic and molecular systems and surfaces. Prereq: CH 442 or equivalent.

CH 444. Chemical Thermodynamics. 4 Credits. The laws of thermodynamics and their applications, including those to nonideal chemical systems. Prereq: CH 413 or equivalent.

CH 445. Statistical Mechanics. 4 Credits. Molecular basis of thermodynamics. Applications to the calculation of the properties of noninteracting and weakly interacting systems. Prereq: CH 413 or equivalent.

CH 446. Chemical Kinetics: [Topic]. 4 Credits. Repeatable. Description and interpretation of the time evolution of chemical systems. Prereq: CH 413 or equivalent.

CH 447. Computational Chemistry. 4 Credits. Introduction to modern computational methods used to understand the properties of molecules. Prereq: CH 411, 412; or PHYS 353.

CH 451. Advanced Organic-Inorganic Chemistry. 4 Credits. Principles of organic-inorganic reaction dynamics; kinetics and mechanisms, linear free-energy relationships, isotope effects, substitution reactions, dynamic behavior of reactive intermediates, electron transfer chemistry. Prereq: CH 336 or CH 341.

CH 452. Advanced Organic Chemistry—Stereochemistry and Reactions. 4 Credits. Principles and applications of stereochemistry; reagents and reactions, with mechanisms, used in contemporary organic synthesis; examples taken from the current literature.

CH 464. RNA Biochemistry. 4 Credits. Introduction to the diverse field of RNA biochemistry. Prereq: CH 463 or BI 320.

CH 465. Physical Biochemistry. 4 Credits. Physical chemical properties of biological macromolecules; forces and interactions to establish and maintain macromolecular conformations; physical bases of spectroscopic, hydrodynamic, and rapid-reaction investigative techniques. Offered alternate years. Prereq: CH 461.

CH 466. Structural Biochemistry. 4 Credits. Protein and nucleic acid structures and energetics. Structure determination by x-ray crystallography and nuclear magnetic resonance. Computational methods for structural analysis. Offered alternate years. Prereq: CH 461.

Please note: Be careful when choosing non-Chemistry 410 courses. Only the 410 courses with the titles below have been approved as advanced electives for the Biochemistry degree.

Biology Courses:

Seats in 400 level Biology courses open to BIC majors at about 9am on day 3 of registration.

****BI 322. Cell Biology.** Eukaryotic cell nuclear structure and exchange, protein trafficking, endocytosis, chaperones, cytoskeletal functions, intercellular junctions, extracellular materials, signaling, cell division mechanics and controls, aging and death. Lectures, discussions. Prereq: BI 214 or BI 282H; CH 331 recommended.

****BI 328. Developmental Biology.** 4 Credits. Topics include genetic regulation, nucleocytoplasmic interactions, organogenesis, morphogenesis, pattern formation, cell differentiation, and neoplasia. Lectures, laboratories. Prereq: BI 214 or BI 282H.

****BI 360. Neurobiology.** 4 Credits. Function of the nervous system from the single neuron to complex neural networks. Topics range from molecular and cellular neurobiological mechanisms to systems and behavioral analyses. Lectures, discussions. Prereq: BI 214 or 282H

BI 410. Analysis Neural Data. 4 Credits. Analysis of Neural Data provides an introduction to statistical and visualization methods for analysis of neuroscientific data using the Matlab programming environment. Students will learn basic concepts and methods from statistics and linear algebra for analysis of high-dimensional data, and learn how to apply these to experimental data by writing Matlab programs. No previous programming experience is required. Pre-reqs: BI 211-214 or BI 281H -283H; and Math 246-247 or Math 251-252. (Suggested additional pre-reqs either Math 243 or BI 399 Intro Experimental Design & Stats.)

BI 410. Biology of Aging. 4 Credits. Aging affects most living organisms and is the primary risk factor for common human diseases such as cancer, cardiovascular disorders, and neurodegeneration. Perhaps surprisingly, rates of aging are under genetic control and vary widely among different species. This course will use primary literature to examine the molecular and cellular mechanisms that regulate aging and to explore approaches that slow or reverse the aging process. Suggested pre-req: Bi 320

BI 410. Chromatin Structure & Function. 4 Credits. This course will examine how eukaryotic DNA is packaged into chromatin, and will explore the structural and regulatory roles of chromatin in DNA-dependent processes. Topics will include nucleosome structure, chromatin modifications, chromatin remodeling enzymes, genome-wide chromatin organization, and emerging methods in chromatin engineering. Prereq: BI 320

BI 410. The Human Microbiome. 4 Credits. We will explore how microbes are ecologically similar to plant and animals, and how they differ. While doing this, we will also explore how information about the ecology of microorganisms can be applied to questions of conservation, environmental management and human health. Prereq: BI 212/213/214 or BI 283. BI 370 Ecology and BI 330/331 Microbiology are recommended.

BI 410. Intro Programming Bio. 4 Credits. Intro Bioinformatics Program is an introduction to computer programming specifically designed for Biology majors. Students will learn basic programming skills, how to write Python scripts to manage project workflows, and gain experience with data analysis and data managements software. No previous programming experience is required, but CIS 122 is a recommended prerequisite.

BI 410. Matlab for Biologists. 4 Credits. Matlab for Biologists provides an introduction to analysis of biological data using the Matlab programming environment. Students will learn basic programming skills and how to apply this to experimental data and numerical simulations. No previous programming experience is required.

BI 410. Microbial Ecology. 4 Credits.

BI 410. Neural Basis Cognition. 4 Credits. The course will examine the neural mechanism that mediate cognitive processes such as attention, memory and decisions making. We will focus on studies that use animal models to relate the activity of single neurons to cognition. The course is intended to bridge the gap between sensory physiology and cognitive neuroscience. Prereq: BI 353 or BI 360.

BI 410. Stem Cells Disease & Medicine. 4 Credits

BI 421. Advanced Molecular Genetics Research Laboratory. 5 Credits. Intensive multipart research project using fungus *Neurospora*; includes mutagenesis, genetic selection-screening, complementation testing, mapping, DNA purification, restriction analysis, polymerase chain reaction, Southern blotting. Prereq: BI 320.

BI 422. Protein Toxins in Cell Biology. 4 Credits. Mechanisms used by protein toxins to kill other organisms and how they have been used as molecular scalpels to dissect pathways in cell and neurobiology. Lectures, discussions. Prereq: BI 322, BI 356, or BI 360.

BI 423. Human Molecular Genetics. 4 Credits. Advanced topics in genetics that relate to human development and disease. The human genome, sex determination, X chromosome inactivation, chromosomal abnormalities, trinucleotide repeat expansions, cancer. Lectures, discussions. Prereq: BI 320.

BI 424. Advanced Molecular Genetics. 4 Credits. Structure and function of chromosomes with emphasis on unsolved genetic problems such as genomic imprinting, position effects, and gene silencing. Lectures, discussions. Prereq: BI 320.

BI 425. Advanced Molecular Biology Research Laboratory. 5 Credits. Provides an intensive, structured research experience that incorporates molecular biology, genetics, and genomic methodologies. Lectures, laboratories. Prereq: one from BI 320, BI 322, BI 328.

BI 426. Genetics of Cancer. 4 Credits. Genetic regulation of cancer. Topics include oncogenes and tumor suppressor genes, signal transduction pathways, genetic animal models, and rationale treatment design. Lectures, discussions. Prereq: BI 320 or BI 322.

BI 427. Molecular Genetics of Human Disease. 4 Credits. Advanced discussions of heritable diseases from single-gene mutations such as cystic fibrosis to complex multigenetic diseases such as autism and schizophrenia. Lectures, discussions. Prereq: BI 320.

BI 428. Developmental Genetics. 4 Credits. Genetic regulation of development, including investigations of molecular mechanisms and studies of developmental mutants. Topics include molecular biology of eukaryotic chromosomes, genetic mosaics, and models of gene regulation. Lectures, discussions. Prereq: BI 320, 328.

BI 433. Bacterial-Host Interactions. 4 Credits. Examines spectrum of interactions between bacteria and animals, from pathogenesis to symbiosis, focusing on the molecular and cellular bases of these interactions. Lectures, discussions. Prereq: BI 320 or 322 or 330.

BI 461. Systems Neuroscience. 4 Credits. Principles of organization of nervous systems with emphasis on vertebrate brain and spinal cord. Functional implications of synaptic organization and pattern of projections, and comparative aspects. Lectures, discussions. Prereq: BI 353 or 360 or equivalent.

BI 463. Cellular Neuroscience. 4 Credits. Physiology of excitation, conduction, and synaptic transmission. Lectures, discussions. Prereq: BI 360.

BI 466. Developmental Neurobiology. 4 Credits. Mechanisms underlying development of the nervous system. The genesis of nerve cells; differentiation of neurons; synaptogenesis and neuronal specificity; plasticity, regeneration, and degeneration of nervous tissue. Lectures, discussions. Prereq: BI 320, 328.

BI 484. Molecular Evolution. 4 Credits. General description of patterns of molecular variation within and between species, underlying mechanisms, and methods of analysis. Prereq: BI 320 or 380.

BI 486. Population Genetics. 4 Credits. Analysis of the genetic mechanisms of evolutionary change. Study of artificial and natural selection, mutation, migration, population structure, and genetic drift.

BI 487. Molecular Phylogenetics. 4 Credits. A critical introduction to the concepts and techniques of modern molecular phylogenetic analysis—the inference of evolutionary relationships from gene sequence data. Lectures, discussions. Prereq: BI 380

BI 493. Genomic Approaches and Analysis. 4 Credits. ntroduction to experimental methods and analytical techniques for studying biological questions on a genome-wide scale. Lectures, discussions. Prereq: BI 320.

Physics Courses:

PHYS 362. Biological Physics. 4 Credits. Physical principles governing biological systems. Topics include: stochastic and entropic forces, diffusion, electrostatics in solution, molecular binding, DNA/polymer mechanics, gene regulation, simple genetic circuits, membrane mechanics, protein folding, simple stochastic processes, and physical mechanisms of self-organization. Pre-requisites: MATH 256, 281.

PHYS 410 Writing Science. 4 Credits. In Writing Science, you will learn to make your science come alive through vivid storytelling. The course will help you develop practical and structured writing skills useful for publishing in peer-reviewed journals, undergraduate and PhD theses, popular scientific reporting, scholarships and grants (e.g. NSF GRFP), and any situation where it is vital to communicate an idea. Furthermore, Writing Science will help you integrate science writing into well-motivated, inspired science. The techniques developed in Writing Science will also be applied to other areas of communication, like oral presentations, posters, and nonscientific writing. Although Writing Science is most appropriate for undergraduate and graduate students who are actively engaged in scientific research, all students are welcome and will benefit from the course.
Prereq: none

Note: Check with the appropriate department to determine when any specific course will be offered.

** Other courses may be submitted for consideration and approval by the department*

***Students may use ONE approved 300-level biology course (BI 321, 322, 328 or 360) as one of the 5 advanced electives.*