

Biochemistry and Biotechnology

General Information

Degrees

Biochemistry and Biotechnology provides academic programs leading to the undergraduate B.S. degree or the graduate M.S. degree in Biochemistry and Biotechnology. These degrees are offered in cooperation with the Department of Biology and the Department of Chemistry and Biochemistry. Faculty members in this program are engaged in teaching and research in areas such as biochemistry, genetics, molecular biology, and cell biology. Majors have the opportunity through coursework, laboratories, seminars, and research experience to develop the knowledge and skills necessary to enter the workforce or to go on with further graduate education.

Career Outlook

The emerging Biotechnology sector is increasing the regional and national demand for workers with significant training in molecular biology, biochemistry, and genetics. The St. Louis metropolitan area has long been a major center for biochemistry and biotechnology, and in the past decade it has become a national hub for life sciences research and development activity. A degree in Biochemistry and Biotechnology provides students with the training they need to become part of the broad biotechnology and life sciences industries.

Biochemistry and Biotechnology BS

Biochemistry and Biotechnology BS/MS Dual Degree Program

Biochemistry and Biotechnology MS

Biochemistry and Biotechnology MS, Professional Emphasis

BIOL 1831 Introductory Biology: From Molecules to Organisms (MOTR BIOL 150L): 5 semester hours

Prerequisites: A minimum of high school chemistry and MATH 1030; ENGL 1100 or equivalent (may be taken concurrently). Required for students intending to major in biology or take specified biology courses at the 2000 level or above. This course presents and introduction to some of the principles of biology and scientific methodology applied to the molecular/ cellular through organ system levels of organization. Topics include: cell structure, metabolism, reproduction, heredity and major physiological processes regulated by organ systems. Three hours of lecture, three and one half hours of lab, and one hour of discussion per week.

BIOL 2012 Genetics: 3 semester hours

Prerequisites: BIOL 1831, MATH 1030, and CHEM 1111. This course covers the fundamental principles of inheritance, including classical genetic theory as well as recent advances in the molecular basis of heredity. It is three (3) hours of lecture per week.

BIOL 2013 Genetics Laboratory: 2 semester hours

Prerequisites: Concurrent registration in BIOL 2012, or consent of instructor. Laboratory to accompany BIOL 2012. Three and one-half hours of organized laboratory time per week. Students may need to return to the laboratory at unscheduled times to complete some exercises.

BIOL 2482 Microbiology: 3 semester hours

Prerequisites: BIOL 1831 (majors must also take BIOL 1821), MATH 1030, and CHEM 1111. Study of microorganisms, their metabolism, genetics, and their interaction with other forms of life. Three hours of lecture per week.

BIOL 2483 Microbiology Laboratory: 2 semester hours

Prerequisite: BIOL 2482 (may be taken concurrently). Experimental studies and procedures of microbiological techniques. Three and one-half hours of organized laboratory time per week. Students will need to return to the laboratory at unscheduled times to complete some exercises.

BIOL 3622 Cell Biology: 3 semester hours

Prerequisites: BIOL 1831, BIOL 2012, CHEM 1121, and MATH 1030. This course examines the organization and basic processes of cells including tissues, organelles, glycolysis, respiration, photosynthesis, trafficking, cytoskeleton, signal transduction, and cell division.

BIOL 3699 Undergraduate Internship in Biotechnology: 1-4 semester hours

Prerequisites: BIOL 1821, BIOL 1831, and CHEM 1111 and CHEM 1121 and consent of instructor. Concurrent enrollment in CHEM 2612 or higher is strongly encouraged. A 2.5 GPA and enrollment in the undergraduate Biotechnology Certificate Program is required. Internship will consist of a period of observation, experimentation and on-the-job training in a biotechnology laboratory. The laboratory may be industrial or academic. Credit will be determined by the number of hours a student works each week and in consultation between the intern's supervisor and instructor. Internship assignments will be commensurate with the education and experience of the student. Two credits may be used to fulfill the lab requirement.

BIOL 4442 Developmental Biology: 3 semester hours

Prerequisites: BIOL 2012 and BIOL 3622. A study of the basic principles that shape the embryonic and post-embryonic development of animals with an emphasis on the underlying cellular and molecular mechanisms. Specific topics include fertilization, determination of cell fate and differentiation, cell migration, establishment of the body plan, formation of selected organs and organ systems, stem cells, and limb regeneration. Environmental influences on development and the impact of developmental biology on modern medicine are also discussed. Three hours of lecture/discussion per week. Students may not receive credit for both BIOL 4442 and BIOL 6442.

BIOL 4550 Bacterial Pathogenesis: 3 semester hours

Prerequisites: BIOL 2012 and BIOL 2482. Examination of the strategies bacterial pathogens use to infect animals. Topics include host immune responses to infection, bacterial virulence factors, regulation of bacterial virulence, and the cellular and molecular approaches used to study host/parasite interactions. Three hours of lecture per week. Students may not receive credit for both BIOL 4550 and BIOL 6550.

BIOL 4602 Molecular Biology: 3 semester hours

Prerequisites: BIOL 2012 and CHEM 2612. This course is a survey of the principles of molecular biology, with emphasis on understanding the genetic regulation of DNA, RNA, and protein synthesis and function in eukaryotic cells.

BIOL 4608 Synthetic Biology: 3 semester hours

Prerequisites: BIOL 2012, BIOL 2482. A study of the molecular biology of microbial cells, in the context of synthetic biological systems. Topics include DNA replication, transcription, translation, gene regulation and protein structure as well as aspects of genetic engineering as they apply to the construction of novel biological systems. Following an introduction to the design of biological parts used in synthetic biology, students read, discuss and present recent journal articles in order to learn about current advances and applications of synthetic biology. Three hours of lecture per week. Students may not receive credit for BIOL 4608 and BIOL 6608.

BIOL 4614 Biotechnology Laboratory I: 4 semester hours

Prerequisites: BIOL 2012 or consent of instructor. An introduction to the fundamental concepts that underlie the field of biotechnology. Both the basic principles of molecular biology and hand-on experience with the techniques of the field will be addressed through lectures, discussions, and a series of laboratory exercises. Two hours of lecture and four hours of laboratory per week. Fulfills a laboratory requirement only; may not be used to fulfill the higher level (4000-5000) lecture course requirement for the B.A. or B.S. degree in biology. Students may not receive credit for BIOL 4614 and a comparable biotechnology course from another institution.

BIOL 4615 Biotechnology Laboratory II: 4 semester hours

Prerequisites: BIOL 4614 and either BIOL 4602 or BIOL 4732 or CHEM 4712, or consent of instructor. This course is an in-depth look at theory and practice of biotechnology. Lectures and discussion will examine the underlying principles, and laboratory exercises will present hands-on experience with current techniques. The course entails one hour of lecture and six hours of laboratory per week. It fulfills a laboratory requirement only and may not be used to fulfill the higher level (4000-5000) lecture course requirement for the B.A. or B.S. degree in Biology. Students may not receive credit for BIOL 4615 and BIOL 6615.

BIOL 4622 Cellular Basis of Disease: 3 semester hours

Prerequisites: BIOL 3622. A study of the structural organization and processes of eukaryotic cells, focusing on how defects in cellular function lead to genetic diseases and cancer. Topics of discussion may include membrane dynamics, intracellular trafficking, signal transduction, and the cell cycle. Three hours of lecture per week. Students may not receive credit for both BIOL 4622 and BIOL 6622.

BIOL 4632 Nucleic Acid Structure and Function: 3 semester hours

Prerequisites: BIOL 2012 and BIOL 4732 or equivalent, or consent of instructor. A comprehensive view of the structural properties of DNA and RNA that promote molecular interactions and biological function. Topics will include the physical properties of nucleic acids, the formation and biological importance of higher order structures, RNA enzymatic activities, nucleic acid-protein interactions, and RNA metabolism. Three hours of lecture per week. Students may not receive credit for both BIOL 4632 and BIOL 6632.

BIOL 4642 Plant Molecular Biology and Biotechnology: 3 semester hours

Prerequisites: BIOL 2012, BIOL 3622. This course will introduce molecular biology principles that govern plant growth, development, and responses to stress. This course integrates the experimental approaches of genetics, molecular biology, and biochemistry, with a specific focus on biotechnology techniques and applications. Students may not receive credit for both BIOL 4642 and BIOL 6642.

BIOL 4652 Virology: 3 semester hours

Prerequisite: BIOL 2012 and BIOL 3622. This first half of the course entails a comparative study of the structure, replication, and molecular biology of viruses. The second half of the course focuses on the pathogenesis, control, and evolution of animal viruses. Three hours of lecture per week. Students may not receive credit for both BIOL 4652 and BIOL 6652.

BIOL 4797 Biochemistry and Biotechnology Seminar: 1 semester hour

Same as CHEM 4797. Prerequisites: Senior standing in the Biochemistry and Biotechnology program and consent of faculty advisor. This course will focus on selected publications related to biochemistry and biotechnology from both refereed journals and news sources. Students are expected to participate in discussions and to prepare oral and written presentations. Completion of the Major Field Achievement Test in Biochemistry & Biotechnology is a course requirement. May not be taken for graduate credit.

BIOL 4822 Introduction to Neuroscience: 3 semester hours

Prerequisite: BIOL 3802 or consent of instructor. The study of nervous systems, featuring the cellular bases of initiation and conduction for the impulse, synaptic transmission, and the network integrative function of invertebrate and vertebrate nervous systems. This course emphasizes the multidisciplinary nature of the neurosciences, including anatomical, physiological and molecular approaches to understanding neural function. Three hours of lecture per week.

BIOL 4842 Immunobiology: 3 semester hours

Prerequisite: BIOL 3622 and CHEM 2612. The fundamental principles and concepts of immunology and immunochemistry. Emphasis on the relation of immunological phenomena to biological phenomena and biological problems. Three hours lecture per week.

BIOL 4905 Research: 1-3 semester hours

Prerequisites: Consent of faculty research advisor. Research in an area selected by the student in consultation with and under the direct supervision of an UMSL biology faculty research adviser. Research opportunities are subject to availability and must be approved in advance of beginning research. The project may include the reading of pertinent literature, laboratory or field experience, including keeping of a logbook, and a summary paper and a presentation, all based on an average 8 hours per week per credit during a 15 week semester at the discretion of the instructor. Credit arranged. Course may be repeated for a total of up to 5 credit hours. A maximum of one lab requirement may be satisfied using any two BIOL 4905 credits. Additional credits may be applied toward the total biology hours required for the biology BA or BS. May not be taken for graduate credit.

BIOL 4920 Selected Topics in Biology: 3 semester hours

Prerequisites: Junior standing and consent of instructor. The topic for this course will vary each semester. Topics offered for the following semester will be posted in the departmental office. This course may be repeated once if the topic is different.

BIOL 5012 Advanced Genetics: 3 semester hours

Prerequisites: BIOL 2012 or consent of instructor. This course explores advanced topics in the study of genetics, including advanced principles of inheritance, classical genetic theory, advances in understanding the nature of genetic material, and the molecular basis of heredity. Variation between individuals and populations will be considered to emphasize the effects of genetics on both medical and evolutionary questions. A particular focus will be placed on identifying, analyzing, and communicating findings from recent primary literature.

BIOL 5069 Topics in Cellular and Molecular Biology: 1 semester hour

Prerequisite: Graduate standing or consent of instructor. Presentation and discussion of student and faculty research projects and/or current research articles in molecular, cellular and developmental biology. May be repeated. Course graded on a satisfactory/unsatisfactory basis.

BIOL 5436 Advanced Applied Bioinformatics: 3 semester hours

Prerequisites: BIOL 4732 or BIOL 4602 or consent of instructor. This course provides an advanced foundation in using various computational approaches to solve biological problems. Specific attention focuses on methods for using and interpreting information from biological databases, analyzing biological sequence information, and making functional and structural predictions. Students may not receive credit for both BIOL 4436 and BIOL 5436.

BIOL 5798 Practicum in Science in Business: 1-2 semester hours

Same as CHEM 5798. Prerequisites: Graduate standing and enrollment in a Professional Science emphasis in Chemistry, Biochemistry & Biotechnology, or Biology. Students will integrate and apply their scientific expertise to a practical, business-related problem. The course will emphasize interdisciplinary team-work as well as both written and oral communication skills.

BIOL 5799 Internship in Sciences in Business: 1-2 semester hours

Same as CHEM 5799. Prerequisites: Graduate standing and enrollment in a Professional Science emphasis area in Chemistry, Biochemistry & Biotechnology, or Biology. The internship will consist of a period of on-the-job training at a local company. Credit hours will be determined by the number of hours the student works each week and in consultation between the intern's supervisor and the course instructor. Internship assignments will be commensurate with the education and experience of the student, with an emphasis on work at the interface between the scientific and business components of the company. A written report describing the internship project is required.

BIOL 6550 Advanced Bacterial Pathogenesis: 3 semester hours

Prerequisites: BIOL 2012 and BIOL 2482. Examination of the strategies bacterial pathogens use to infect animals. Topics include host immune responses to infection, bacterial virulence factors, regulation of bacterial virulence, and the cellular and molecular approaches used to study host-parasite interactions. Students may not receive credit for both BIOL 6550 and BIOL 4550. Students will be required to give an oral presentation and/or write an extra paper on a topic relevant to the course. Three hours of lecture per week.

BIOL 6602 Advanced Molecular Biology: 3 semester hours

Prerequisites: BIOL 2012 and CHEM 2612, or consent of instructor. This course covers advanced principles of molecular biology, with an emphasis on primary literature. Students may be required to give an oral presentation and/or write papers on a topic relevant to the course. Students may not receive graduate credit for both BIOL 4602 and BIOL 6602.

BIOL 6608 Advanced Synthetic Biology: 3 semester hours

Prerequisites: BIOL 2012, BIOL 2482. A study of the molecular biology of microbial cells, in the context of synthetic biological systems. Topics include DNA replication, transcription, translation, gene regulation and protein structure as well as aspects of genetic engineering as they apply to the construction of novel biological systems. Following an introduction to the design of biological parts used in synthetic biology, students read, discuss and present recent journal articles in order to learn about current advances and applications of synthetic biology. Three hours of lecture per week. Students may not receive credit for both BIOL 4608 and BIOL 6608.

BIOL 6615 Advanced Biotechnology Laboratory II: 4 semester hours

Prerequisites: BIOL 4602 or BIOL 4732 or CHEM 4712, or consent of instructor. This course is an advanced analysis of the theory and practice of biotechnology. Lectures and discussion will examine the underlying principles, and laboratory exercises will present hands-on experience with current techniques. It entails one hour of lecture and six hours of laboratory per week. Students may not receive credit for both BIOL 6615 and BIOL 4615.

BIOL 6622 Advanced Cellular Basis of Disease: 3 semester hours

Prerequisites: BIOL 3622, or consent of instructor. A study of the structural organization and processes of eukaryotic cells, focusing on how defects in cellular function lead to genetic diseases and cancer. Topics of discussion may include membrane dynamics, intracellular trafficking, signal transduction, and the cell cycle. Three hours of lecture per week. Students may not receive credit for both BIOL 6622 and BIOL 4622.

BIOL 6632 Advanced Nucleic Acid Structure and Function: 3 semester hours

Prerequisites: BIOL 2012 and BIOL 4732 or equivalent, or consent of instructor. A comprehensive view of the structural properties of DNA and RNA that promote molecular interactions & biological function. Topics will include the physical properties of nucleic acids, the formation and biological importance of higher order structures, RNA enzymatic activities, nucleic acid-protein interactions, and RNA metabolism. Three hours of lecture and one hour of discussion per week. Students may not receive credit for both BIOL 4632 and BIOL 6632.

BIOL 6642 Advanced Plant Biology and Biotechnology: 3 semester hours

Prerequisites: Graduate standing. This course will introduce molecular biology principles that govern plant growth, development, and responses to stress. This course integrates the experimental approaches of genetics, molecular biology, and biochemistry, with a specific focus on biotechnology techniques and applications. Student may not receive credit for both BIOL 4642 and BIOL 6642.

BIOL 6652 Advanced Virology: 3 semester hours

Prerequisites: BIOL 2012, BIOL 3622, and graduate standing. This first half of the course entails a comparative study of the structure, replication, and molecular biology of viruses. The second half of the course focuses on the pathogenesis, control, and evolution of animal viruses. Three hours of lecture, one hour of discussion or seminar per week. Students may not receive credit for both BIOL 4652 and BIOL 6652.

BIOL 6699 Graduate Internship in Biotechnology: 1-4 semester hours

Prerequisites: Graduate standing and enrollment in graduate Biotechnology Certificate Program. 6 credit hours maximum (maximum of 8 combined credit hours of BIOL 6905 and internship) Internship will consist of period of observation, experimentation and on-the-job training in biotechnology laboratory. The laboratory may be industrial or academic. Credit will be determined by the number of hours the student works each week and in consultation between the intern's supervisor and the instructor. Internship assignments will be commensurate with the education and experience of the student.

BIOL 6889 Graduate Seminar: 2 semester hours

Presentation and discussion of various research problems in biology. Graduate student exposure to the seminar process.

BIOL 6905 Graduate Research in Biology: 1-10 semester hours

Research in area selected by student in consultation with faculty members.

BIOL 6915 Graduate Research Practicum: 1-2 semester hours

Prerequisite: Consent of instructor. This course is designed for graduate students wishing to pursue research experience in an area outside their dissertation topic. The project can be techniques-oriented or focused on a specific research question. The credit hours will depend on the time commitment to the project as decided by the supervisory faculty member.

CHEM 1111 Introductory Chemistry I (MOTR CHEM 150L): 5 semester hours

Prerequisite: MATH 1030 (or a score of 26 or higher on either the Math ACT or the Missouri Math Placement Test) and MATH 1035 (MATH 1035 may be taken concurrently). Presents an introduction to the fundamental laws and theories of chemistry. Laboratory experiments are designed to demonstrate some aspects of qualitative and quantitative analysis and to develop skills in laboratory procedures. Chemistry majors may not include both CHEM 1011 and CHEM 1111 in the 120 hours required for graduation. Three hours of lecture, one and one-half hours of workshop, and three hours of laboratory per week.

CHEM 1121 Introductory Chemistry II: 5 semester hours

Prerequisite: CHEM 1111 or advanced placement. Lecture and laboratory are a continuation of CHEM 1111. Three hours of lecture, one and one-half hours of workshop and three hours laboratory per week.

CHEM 2223 Quantitative Analysis in Chemistry: 3 semester hours

Prerequisites: CHEM 1121. This course covers basic analytical chemistry theory and techniques, principles of experimental error analysis, and the application of statistics to data treatment. A significant proportion of the laboratory experiments emphasize quantification of unknown samples.

CHEM 2612 Organic Chemistry I: 3 semester hours

Prerequisite: CHEM 1121 (may be taken concurrently). An introduction to the structure, properties, synthesis, and reactions of aliphatic and aromatic carbon compounds. Three hours of lecture per week.

CHEM 2622 Organic Chemistry II: 3 semester hours

Prerequisite: CHEM 2612. A systematic study of organic reactions and their mechanisms; organic synthetic methods. Three hours of lecture per week.

CHEM 2633 Organic Chemistry Laboratory: 2 semester hours

Prerequisite: CHEM 2612. An introduction to laboratory techniques and procedures of synthetic organic chemistry including analysis of organic compounds. One hour of lecture and four and one-half hours of laboratory per week.

CHEM 3643 Advanced Organic Chemistry Laboratory: 2 semester hours

Prerequisites: CHEM 2223, CHEM 2622, CHEM 2633, and CHEM 3022 (may be taken concurrently). Identification of organic compounds by classical and spectroscopic methods; advanced techniques in synthesis and separation of organic compounds. One hour of lecture and four and one-half hours of laboratory per week. Not for graduate credit.

CHEM 3905 Chemical Research: 1-10 semester hours

Prerequisite: Consent of instructor. Independent laboratory and library study, in conjunction with faculty member, of fundamental problems in chemistry. A written report describing the research is required.

CHEM 4302 Survey of Physical Chemistry with Applications to the Life Sciences: 3 semester hours

Prerequisites: CHEM 2612 and MATH 1800 or MATH 1100, and PHYSICS 1012. This course covers the principles of physical chemistry with applications to the life sciences. Topics will include thermodynamics, equilibria, kinetics, and spectroscopy. This course will be taught simultaneously with CHEM 3302, but students in CHEM 4302 will have additional assignments or projects. No student may receive credit for both CHEM 3302 and CHEM 4302.

CHEM 4712 Biochemistry: 3 semester hours

Prerequisites: CHEM 2622. This course examines the chemistry and function of cell constituents, and the interaction and conversions of intracellular substances. Students may not receive credit for both BIOL 4732 and CHEM 4712.

CHEM 4722 Advanced Biochemistry: 3 semester hours

Prerequisite: CHEM 4712. This course covers selected advanced topics in the chemistry of life processes. Students may not receive credit for both CHEM 4722 and CHEM 5722.

CHEM 4733 Biochemistry Laboratory: 2 semester hours

Prerequisites: CHEM 4712 (may be taken concurrently), and CHEM 2223. Laboratory study of biochemical processes in cellular and subcellular systems with emphasis on the isolation and purification of proteins (enzymes) and the characterization of catalytic properties. One hour of lecture and four and one-half hours of laboratory per week.

CHEM 4772 Physical Biochemistry: 3 semester hours

Prerequisites: CHEM 3312 or CHEM 4712 or BIOL 4732. This course is designed to acquaint students with concepts and methods in biophysical chemistry. Topics that will be discussed include protein and DNA structures, forces involved in protein folding and conformational stability, protein-DNA interactions, methods for characterization and separation of macromolecules, and biological spectroscopy. Students may not receive credit for both CHEM 4772 and CHEM 5772.

CHEM 4774 Introduction to Bioinformatics: 3 semester hours

Prerequisites: CHEM 4712 or equivalent. This course introduces modern approaches in bioinformatics and computational biochemistry. Topics covered include a survey of biological databases, predictions from protein and DNA sequences, sequence alignment and sequence database searches, building phylogenetic trees, three-dimensional protein structure prediction, molecular modeling and simulation, and computational genomics. Students may not receive credit for both CHEM 4774 and CHEM 5774.

CHEM 4797 Biochemistry and Biotechnology Seminar: 1 semester hour

Same as CHEM 4797. Prerequisites: Senior standing in the Biochemistry and Biotechnology program and consent of faculty advisor. This course will focus on selected publications related to biochemistry and biotechnology from both refereed journals and news sources. Students are expected to participate in discussions and to prepare oral and written presentations. Completion of the Major Field Achievement Test in Biochemistry & Biotechnology is a course requirement. May not be taken for graduate credit.

CHEM 4814 Special Topics in Chemistry: 1-10 semester hours

A reading and seminar course in selected advanced topics.

CHEM 4897 Seminar in Chemistry: 2 semester hours

Prerequisites: CHEM 3022 and senior standing. This course will provide students with the opportunity to listen to talks presented by students, faculty, and invited speakers. Students must complete a comprehensive examination before the end of the course. Chemistry majors should enroll during the semester in which they intend to graduate, or during their next-to-last semester before graduation.

CHEM 5212 Advanced Instrumental Analysis: 3 semester hours

Prerequisites: Graduate standing and consent of instructor. This course covers the principles and applications of modern methods of instrumental analysis for analytical chemistry measurements. Topics may be selected from, but are not limited to, the areas of electrochemistry, absorption and emission spectroscopy, chromatography, mass spectrometry, surface analysis, and nuclear magnetic resonance. Additional independent study and work are required. Students may not receive credit for both CHEM 4212 and CHEM 5212.

CHEM 5294 Special Topics in Analytical Chemistry: 1-3 semester hours

Prerequisites: Consent of instructor. This course covers topics in analytical chemistry that may change from semester to semester, and more than one course or topic may be offered in a given semester. Topics may be selected from the areas of chromatography, mass spectrometry, analytical spectroscopy, thermal analysis, X-ray diffraction, surface analysis, magnetism, ion-exchange, size-exclusion chromatography, or other topics in modern analytical chemistry. The course may be taken more than once for credit provided that topic(s) are different in each case.

CHEM 5302 Foundations of Physical Chemistry: 3 semester hours

Prerequisites: Consent of Instructor. A survey of fundamental and advanced topics in physical chemistry including thermodynamics, kinetics, quantum chemistry, and spectroscopy. Three hours of lecture per week. Additional independent study work is required. Students may not receive credit for both CHEM 4302 and CHEM 5302.

CHEM 5394 Special Topics in Physical Chemistry: 1-3 semester hours

Prerequisite: Consent of instructor. The topic for this course may change from semester to semester, and more than one course or topic can be offered in a given semester. The course may be taken more than once for credit provided that the topic is different in each case. The course can have more than one instructor.

CHEM 5396 Directed Readings in Physical Chemistry: 1-3 semester hours

Prerequisites: Consent of Physical Chemistry Faculty. A series of readings of monographs, review papers, and/or research publications for a particular student directed at providing that student with appropriate background preparation for experimental or theoretical Ph.D.-level research in an area of physical chemistry. The particular readings will be selected by the physical chemistry staff. Potential topics include but are not limited to advances in Electrochemistry, Surface Chemistry, Thermodynamics, Molecular Spectroscopy, Quantitative Absorption Spectroscopy using new Methodologies, Applications of Group Theory in Spectroscopy, and Computational Chemistry. Assessment may be in various forms including by assignments and seminars. Students may take this course more than once for credit through the particular topic must be different in each case.

CHEM 5494 Special Topics in Inorganic Chemistry: 1-3 semester hours

Prerequisite: Consent of instructor. The topic for this course may change from semester to semester, and more than one course or topic can be offered in a given semester. The course may be taken more than once for credit provided that the topic is different in each case. The course can have more than one instructor.

CHEM 5612 Advanced Organic Chemistry II - Reactions And Synthesis: 3 semester hours

Prerequisite: CHEM 2622. This course will examine a variety of organic transformations typically utilized in organic synthesis. Topics will include carbon-carbon bond formation, pericyclic reactions, oxidation, reduction, and functional group interconversions. Mechanism and stereochemistry will be emphasized. Three hours of lecture per week.

CHEM 5652 Spectroscopic Identification of Organic Compounds: 3 semester hours

Prerequisites: Graduate standing or CHEM 3643. An applied approach to the use of spectroscopic techniques in organic chemistry. Topics to include integrated applications of infrared and Raman spectroscopy, ^{13}C and ^1H nuclear magnetic resonance spectroscopy and mass spectroscopy for the purpose of elucidating the structure and dynamics of organic compounds. Three hours of lecture per week.

CHEM 5694 Special Topics in Organic Chemistry: 1-3 semester hours

Prerequisite: Consent of instructor. The topic for this course may change from semester to semester, and more than one course or topic can be offered in a given semester. The course may be taken more than once for credit provided that the topic is different in each case. The course can have more than one instructor.

CHEM 5774 Bioinformatics: 3 semester hours

Prerequisites: CHEM 4712 or equivalent. This course introduces modern approaches in bioinformatics and computational biochemistry. Topics to be covered include a survey of biological databases, predictions from protein and DNA sequences, sequence alignment and sequence database searches, building phylogenetic trees, three-dimensional protein structure prediction, molecular modeling and simulation, and computational genomics. Additional independent study work is required. Students may not receive credit for both CHEM 4774 and CHEM 5774.

CHEM 5794 Special Topics in Biochemistry: 1-3 semester hours

Prerequisites: Consent of instructor. The topic for this course may change from semester to semester, and more than one course or topic can be offered in a given semester. The course may be taken more than once for credit provided that the topic is different in each case. The course can have more than one instructor.

CHEM 5798 Practicum in Science in Business: 1-2 semester hours

Same as: BIOL 5798. Prerequisites: Graduate standing and enrollment in a Professional Science emphasis in Chemistry, Biochemistry & Biotechnology, or Biology. Students will integrate and apply their scientific expertise to a practical, business-related problem. The course will emphasize interdisciplinary team-work as well as both written and oral communication skills.

CHEM 5799 Internship in Science in Business: 1-2 semester hours

Same as: BIOL 5799. Prerequisites: Graduate standing and enrollment in a Professional Science emphasis area in Chemistry, Biochemistry & Biotechnology, or Biology. The internship will consist of period of on-the-job training at a local company. Credit hours will be determined by the number of hours the student works each week and in consultation between the intern's supervisor and the course instructor. Internship assignments will be commensurate with the education and experience of the student, with an emphasis on work at the interface between the scientific and business components of the company. A written report describing the internship project is required.

CHEM 6787 Problem Seminar in Biochemistry: 1 semester hour

Prerequisite: Consent of the biochemistry staff. Problems from the current literature, presentations and discussions by faculty, students and visiting scientists. Ph.D. students may take more than once for credit. Up to three credits may be applied to the M.S. degree program.

CHEM 6897 Chemistry Colloquium: 1 semester hour

This course consists of presentations of papers by faculty and invited speakers. It meets for one hour per week.

CHEM 6905 Graduate Research in Chemistry: 1-10 semester hours