

Chemistry (CHEM)

Course information contained within the Bulletin is accurate at the time of publication in July 2024 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

CHEM 0821. Chemistry of Wine. 3 Credit Hours.

This course is typically offered in Fall.

Wine has occupied a central role in human culture. In our exploration of the science of wine we will learn why wine was the beverage of choice through the ages, why a bottle of wine can range from \$2 to \$2,000, how wine is made, what makes a good/bad wine, how is white different from red, and how we know what is in a bottle of wine. The course begins with a large scale fermentation of red and white wine and will continue with team-based analyses of the two month process of turning grape juice into wine. Many aspects of the production and consumption of wine will be addressed in this course.

NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and the Science & Technology Second Level (SB) requirement for students under Core.

Course Attributes: GS

Repeatability: This course may not be repeated for additional credits.

CHEM 0838. Nature Has No Reverse. 3 Credit Hours.

This course is not offered every year.

Rapid advances in modern science often tend to conceal the "forest in the trees," but we all need enough familiarity with the "scientific method" to make informed judgments as citizens and voters. This course will take you on a journey through the history of science, with stops at the Second Law of Thermodynamics, the "revolution" of fire, the rational basis of life, energy as the universal currency and changes in the universe around us. We will end with that most disturbing of paradoxes: the certainty of uncertainty. Each week includes both lecture and hands-on demonstration/practicum. NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and the Science & Technology Second Level (SB) requirement for students under Core.

Course Attributes: GS, SI

Repeatability: This course may not be repeated for additional credits.

CHEM 0877. The Chemistry of Global Environmental Issues. 3 Credit Hours.

Global warming. Climate change. Ozone Layer. Carbon Footprint. Ocean Acidification. Pollution. The Greenhouse Gas Effect. The ramifications of these issues, for the environment you live in are debated in such venues as the living (and dorm) room, the news, the halls of Congress, and the United Nations. The primary objective of this course is to pull back the veil on the scientific aspects of these topics while giving you the scientific background so that you can better understand and evaluate the potential impact of these significant environmental topics.

Course Attributes: GS, SE, SF

Repeatability: This course may not be repeated for additional credits.

CHEM 1005. Practice and Development of Spatial Visualization Skills. 1 Credit Hour.

The ability to mentally visualize in three dimensions is an important skill for scientists. In this course, students will move through ten different modules that will strengthen spatial reasoning and visualization skills. All assigned work will be completed during the scheduled class time. This course is restricted to students taking CHEM 1031, 1035, or 1951, and who have scored less than 70% on the PSVT:R.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1031 (may be taken concurrently), CHEM 1035 (may be taken concurrently), or CHEM 1951 (may be taken concurrently))

CHEM 1006. Knowing Where to Start: Taking the Problem Out of Chemistry Problem Solving. 1 Credit Hour.

How do chemists understand a problem and figure out a plan to solve it? This course approaches problem solving as a way of thinking, helping students to succeed in introductory chemistry and beyond. The strategies explored in logic, math, and reading will be applied to challenges across human health and the environment.

Repeatability: This course may not be repeated for additional credits.

CHEM 1011. Chemistry: The Study of Matter I. 4 Credit Hours.

This course is typically offered in Fall and Spring.

Four hours of lecture and demonstration per week; intended to be the primary course for those who take chemistry only to satisfy their Core requirements. Important chemical phenomena and their explanations. Special emphasis on the use of chemical theories and development of mathematical skills needed for their use. NOTE: (1) Because fundamental science is presented, this sequence is also recommended for students who would like to enter a scientific field but fear their background is not adequate. (2) This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement.

Course Attributes: SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (any MATH course numbered 0701 to 0702, any MATH course numbered 0800 to 4999 (may be taken concurrently), 'Y' in MC3, 'Y' in MC4, 'Y' in MC5, 'Y' in MC6, STAT 1001 (may be taken concurrently), 'Y' in STT2, STAT 1102 (may be taken concurrently), STAT 1902 (may be taken concurrently), 'Y' in MC3A, 'Y' in MC6A, 'Y' in MATW, 'Y' in MC3S, 'Y' in MC3D, 'Y' in MC3O, 'Y' in MC3T, or 'Y' in MC6T)

CHEM 1021. Introduction to Chemistry I. 3 Credit Hours.

This course is typically offered in Fall and Summer I.

The first semester of a course designed for the non-science major, introducing chemical principles in the context of everyday life. Fundamental concepts of chemistry including atomic theory, the mole concept, acids and bases, and physical properties of substances. NOTE: (1) Appropriate for some Allied Health students; check the requirements of your program. (2) This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Course Attributes: SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (any MATH course numbered 0701 to 0702 (C or higher), any MATH course numbered 1021 to 4999 (may be taken concurrently), 'Y' in MC3, 'Y' in MC4, 'Y' in MC5, 'Y' in MC6, 'Y' in MA01, STAT 1001 (may be taken concurrently), 'Y' in STT2, STAT 1102 (may be taken concurrently), STAT 1902 (may be taken concurrently), 'Y' in MC3A, 'Y' in MC6A, 'Y' in MATW, 'Y' in MC3S, 'Y' in CRMA18, 'Y' in MC3D, 'Y' in MC3O, 'Y' in MC3T, or 'Y' in MC6T)

CHEM 1022. Introduction to Chemistry II. 3 Credit Hours.

This course is typically offered in Spring and Summer II.

An introduction to organic and biochemistry. Emphasis on relationships between carbon compounds and the chemistry of living systems, the interaction of chemical science with current technology, and chemicals in the environment. NOTE: This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Course Attributes: SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 1021.

CHEM 1023. Introduction to Chemistry Laboratory I. 1 Credit Hour.

This course is typically offered in Fall and Summer I.

Introduction to experimental inorganic chemistry and general chemical techniques. NOTE: This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Course Attributes: SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (any MATH course numbered 0701 to 0702 (C or higher), any MATH course numbered 1021 to 4999 (may be taken concurrently), 'Y' in MC3, 'Y' in MC4, 'Y' in MC5, 'Y' in MC6, 'Y' in MA01, STAT 1001 (may be taken concurrently), 'Y' in STT2, STAT 1102 (may be taken concurrently), STAT 1902 (may be taken concurrently), 'Y' in MC3A, 'Y' in MC6A, 'Y' in MATW, 'Y' in MC3S, 'Y' in CRMA18, 'Y' in MC3D, 'Y' in MC3O, 'Y' in MC3T, or 'Y' in MC6T) and CHEM 1021 (may be taken concurrently)

CHEM 1024. Introduction to Chemistry Laboratory II. 1 Credit Hour.

This course is typically offered in Spring and Summer II.

Introduction to experimental organic and biological chemistry. NOTE: This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Course Attributes: SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 1023 and CHEM 1022 (may be taken concurrently)

CHEM 1027. Applications of Chemistry. 4 Credit Hours.

This course is typically offered in Fall, Spring, and Summer II.

This course is a transition semester of chemistry to be taken before Chemistry 1031 (C071) designed for students who have not had enough preparation in chemistry or mathematics to directly take Chemistry 1031 (C071). Mathematical concepts and chemical principles will be integrated into a series of common applications. In this class, students will learn proper handling of laboratory materials and perform experiments that are integrated with, as well as introduce and reinforce, the material from the lecture. This course is intended to prepare students for General Chemistry by emphasizing the mathematical basis of chemistry and laboratory measurements. A quantitative introduction to atomic and molecular structure, states of matter, basic thermodynamics, solutions, gas laws, kinetics, and equilibrium. NOTE: Students must register for 2 sections: one of which is a combination of lecture and lab for 4 credits and the other is a 0 credit recitation.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C (except where noted) in (MATH 1021 (may be taken concurrently), any MATH course numbered 1022 to 4999 (C- or higher; may be taken concurrently), 'Y' in MC5, 'Y' in MC6, STAT 1001, STAT 1102, STAT 1902, 'Y' in MC6A, 'Y' in MATW, 'Y' in CRMA04, 'Y' in CRST01, 'Y' in CRST02, or 'Y' in MC6T)

CHEM 1031. General Chemistry I. 3 Credit Hours.

The first semester of chemistry for science majors, pre-professional students, and others in science related fields. A quantitative introduction to atomic and molecular structure, states of matter, basic thermodynamics, and solutions.

Course Attributes: SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1021, any MATH course numbered 1022 to 4999 (may be taken concurrently), 'Y' in MC5, 'Y' in MC6, 'Y' in MA03, STAT 1001, STAT 1102, 'Y' in MC6A, 'Y' in MATW, or 'Y' in MC6T)

CHEM 1032. General Chemistry II. 3 Credit Hours.

The second semester of chemistry for science majors, pre-professional students, and others in science related fields. An introduction to thermodynamics, equilibrium, kinetics, electrochemistry, and descriptive chemistry.

Course Attributes: SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1031, CHEM 1041, or CHEM 1951) and (MATH 1021, any MATH course numbered 1022 to 4999 (may be taken concurrently), 'Y' in MC5, 'Y' in MC6, STAT 1001, STAT 1102, 'Y' in MC6A, 'Y' in MATW, or 'Y' in MC6T)

CHEM 1033. General Chemistry Laboratory I. 1 Credit Hour.

An introduction to experimental chemistry, including the determination of molecular weights, calorimetry, and fundamental analytical techniques.

Course Attributes: SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1021, any MATH course numbered 1022 to 4999 (may be taken concurrently), 'Y' in MC5, 'Y' in MC6, STAT 1001, STAT 1102, 'Y' in MC6A, 'Y' in MATW, or 'Y' in MC6T) and (CHEM 1031 (may be taken concurrently), CHEM 1035 (may be taken concurrently), CHEM 1041 (may be taken concurrently), or CHEM 1951 (may be taken concurrently))

CHEM 1034. General Chemistry Laboratory II. 1 Credit Hour.

Experiments in equilibrium, kinetics, acid-base and oxidation reduction titrations, electrochemistry, and synthesis of metal complexes.

Course Attributes: SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1033, CHEM 1043, or CHEM 1953), (CHEM 1032 (may be taken concurrently), CHEM 1042 (may be taken concurrently), or CHEM 1952 (may be taken concurrently)), and (MATH 1021, any MATH course numbered 1022 to 4999 (may be taken concurrently), 'Y' in MC5, 'Y' in MC6, STAT 1001, STAT 1102, 'Y' in MC6A, 'Y' in MATW, or 'Y' in MC6T)

CHEM 1035. Chemistry for Engineers. 3 Credit Hours.

This course is typically offered in Fall and Spring.

The course is specifically designed to provide Engineering students with a concise, but comprehensive treatment of chemical principles. An objective of the course is to present concepts in an engineering context. This will be accomplished in part by discussing how chemical principles provide a foundation for engineering and technology. Topics to be included will be states of matter, reaction stoichiometry, atomic and molecular structure, chemical equilibria, thermodynamics, and kinetics. The course will consist of three hours of lecture and one hour of recitation per week. CHEM 1033 is normally taken concurrently.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C (except where noted) in (MATH 1022, any MATH course numbered 1038 to 4999 (C- or higher; may be taken concurrently), 'Y' in MC6, 'Y' in MA04, 'Y' in MC6A, 'Y' in MATW, 'Y' in CRMA05, or 'Y' in MC6T)

CHEM 1036. Chemistry Laboratory for Engineers. 1 Credit Hour.

This is a lab course that is designed to be coordinated with the Chemistry for Engineers lecture course (Chem 1035). Ideally, the lab will be taken concurrently with the lecture course. The course will be an introduction to experimental chemistry; hands-on experience with lab equipment, fundamentals of qualitative and quantitative chemistry in the various fields: analytical, physical, synthetic and applied chemistry. One three-hour laboratory per week.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (MATH 1022 (C or higher), any MATH course numbered 1038 to 4999 (may be taken concurrently), 'Y' in MC6, 'Y' in MA04, 'Y' in MC6A, 'Y' in MATW, 'Y' in CRMA05, or 'Y' in MC6T) and (CHEM 1035 (may be taken concurrently) or CHEM 1032 (may be taken concurrently))

CHEM 1051. General Chemistry I for Pre-Health Postbaccalaureates. 3 Credit Hours.

This is the first semester of general chemistry for post-baccalaureate students. It includes a quantitative introduction to atomic and molecular structure, states of matter, basic thermodynamics, and solutions. These topics will be covered with special consideration of their relevance to the health sciences.

Repeatability: This course may not be repeated for additional credits.

CHEM 1052. General Chemistry II for Pre-Health Postbaccalaureates. 3 Credit Hours.

This is the second semester of general chemistry for post-baccalaureate students. It includes an introduction to thermodynamics, equilibrium, kinetics, electrochemistry, and descriptive chemistry. These topics will be covered with special consideration of their relevance to the health sciences. Note: To register for this course, students must satisfy the prerequisite or obtain permission from the program director.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in CHEM 1051.

CHEM 1053. General Chemistry I Lab for Pre-Health Postbaccalaureates. 1 Credit Hour.

This course is typically offered in Summer I.

This is the laboratory to accompany the first semester of general chemistry for post-baccalaureate students. It includes a quantitative introduction to atomic and molecular structure, states of matter, basic thermodynamics, and solutions. These topics will be covered with special consideration of their relevance to the health sciences.

Repeatability: This course may not be repeated for additional credits.

CHEM 1054. General Chemistry II Lab for Pre-Health Postbaccalaureates. 1 Credit Hour.

This course is typically offered in Summer II.

This is the laboratory to accompany the second semester of general chemistry for post-baccalaureate students. It includes hands-on investigations of an introduction to thermodynamics, equilibrium, kinetics, electrochemistry, and descriptive chemistry. These topics will be covered with special consideration of their relevance to the health sciences. Note: To register for this course, students must satisfy the prerequisites or obtain permission from the program director.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in CHEM 1052 (may be taken concurrently) and CHEM 1053.

CHEM 1055. Introduction to Problem Solving and Logical Thinking for Pre-Health Postbaccalaureates. 1 Credit Hour.

The ability to solve problems and think logically is essential for success in health professions schools because health professionals must be able to put together patient symptoms, test results, and current research to determine the best course of action for the patient in question. As a result, entrance exams for health professions schools test the ability to think and solve problems logically. However, the techniques of good problem solving are rarely explicitly taught at any point in a student's education, and science majors rarely take logic courses. This course seeks to fill that gap in a way that is geared specifically toward what is needed for pre-health students to succeed in their classes and on standardized tests. This course teaches students good problem-solving techniques and the basics of deductive and inductive logic. The students will spend class time practicing and applying the techniques and principles they are taught, either individually or in pairs/groups. This design will enable them to develop their skills of problem solving and logical thinking so that they can apply them not only to their classes, but to entrance exams for professional school and the practice of their profession as well.

Repeatability: This course may not be repeated for additional credits.

CHEM 1951. Honors General Chemical Science I. 3 Credit Hours.

This course is typically offered in Fall.

When taken with Chemistry 1953 (H093), this course meets pre-professional requirements. Similar to Chemistry 1031 (C071) but with added emphasis on topics of current interest to the professional chemist. NOTE: This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (MATH 1041 (C or higher; may be taken concurrently), MATH 1941 (C or higher; may be taken concurrently), MATH 1038 (C or higher; may be taken concurrently), MATH 1042 (may be taken concurrently), MATH 1044 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1951 (may be taken concurrently), any MATH course numbered 2043 to 3080 (D or higher; may be taken concurrently), 'Y' in MA06, 'Y' in MATW, 'Y' in CRMA08, or 'Y' in CRMA21)

CHEM 1952. Honors General Chemical Science II. 3 Credit Hours.

This course is typically offered in Spring.

Similar to Chemistry 1032 (C072), but with added emphasis on topics of current interest to the professional chemist. NOTE: This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 1951 and (MATH 1042 (may be taken concurrently), MATH 1044 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1951, any MATH course numbered 2043 to 3080 (may be taken concurrently), 'Y' in MA07, or 'Y' in MATW)

CHEM 1953. Honors Chemical Science Laboratory I. 1 Credit Hour.

This course is typically offered in Fall.

An introduction to the experimental techniques employed in the determination of the physical and chemical properties of matter. NOTE: This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (MATH 1041 (C or higher; may be taken concurrently), MATH 1941 (C or higher; may be taken concurrently), MATH 1038 (C or higher; may be taken concurrently), MATH 1042 (may be taken concurrently), MATH 1044 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1951 (may be taken concurrently), any MATH course numbered 2043 to 3080 (D or higher; may be taken concurrently), 'Y' in MA06, 'Y' in MATW, 'Y' in CRMA08, or 'Y' in CRMA21) and (CHEM 1031 (may be taken concurrently), CHEM 1041 (may be taken concurrently), or CHEM 1951 (may be taken concurrently))

CHEM 1954. Honors Chemical Science Laboratory II. 1 Credit Hour.

This course is typically offered in Spring.

Introduction to the experimental techniques employed in the determination of the physical and chemical properties of matter. NOTE: This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 1951, CHEM 1953, and CHEM 1952 (may be taken concurrently)

CHEM 2201. Organic Chemistry I. 3 Credit Hours.

Structure, synthesis, and reactivity of hydrocarbons and their simple derivatives. Principles of organic spectroscopy and stereochemistry. Introductory study of kinetics and reaction mechanisms.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032, CHEM 1042, or CHEM 1952)

CHEM 2202. Organic Chemistry II. 3 Credit Hours.

Detailed examination of the more common functional groups and their reaction chemistry. Emphasis on development of organochemical reasoning powers through planning of multi-step syntheses and solution of structural problems by the combination of chemical and spectroscopic methods. Applications of organic chemistry to biological systems.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2201, CHEM 2211, or CHEM 2921)

CHEM 2203. Organic Chemistry Laboratory I. 1 Credit Hour.

An introduction to microscale laboratory techniques in organic chemistry. Emphasis on learning to manipulate equipment and on efficient separation and purification of organic compounds.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1034, CHEM 1044, or CHEM 1954) and (CHEM 2201 (may be taken concurrently), CHEM 2211 (may be taken concurrently), or CHEM 2921 (may be taken concurrently))

CHEM 2204. Organic Chemistry Laboratory II. 1 Credit Hour.

A continuation of Chemistry 2203 (0123). Preparation, purification, and analysis, including multi-step sequences, of typical moderately complicated organic compounds.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2203, CHEM 2213, or CHEM 2923) and (CHEM 2202 (may be taken concurrently), CHEM 2212 (may be taken concurrently), or CHEM 2922 (may be taken concurrently))

CHEM 2211. Organic Chemistry for Majors I. 3 Credit Hours.

This course is typically offered in Fall.

Structure, synthesis, and reactivity of hydrocarbons and their simple derivatives. Principles of organic spectroscopy and stereochemistry. Introductory study of kinetics and reaction mechanisms. Presentation focused on topics of interest to the professional chemist.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032, CHEM 1042, or CHEM 1952)

CHEM 2212. Organic Chemistry for Majors II. 3 Credit Hours.

This course is typically offered in Spring.

Detailed examination of the more common functional groups and their reaction chemistry. Emphasis on development of organochemical reasoning powers through planning of multi-step syntheses and solution of structural problems by the combination of chemical and spectroscopic methods. Applications of organic chemistry to the chemical profession.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2201, CHEM 2211, or CHEM 2921)

CHEM 2213. Organic Majors Laboratory I. 1 Credit Hour.

This course is typically offered in Fall.

Introduction to organic chemical laboratory techniques, including spectroscopy and chromatography. Hands-on approach with individualized demonstration and instruction.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1034, CHEM 1044, or CHEM 1954) and (CHEM 2201 (may be taken concurrently), CHEM 2211 (may be taken concurrently), or CHEM 2921 (may be taken concurrently))

CHEM 2214. Organic Majors Laboratory II. 1 Credit Hour.

This course is typically offered in Spring.

Advanced organic chemical laboratory techniques, including spectroscopy and chromatography. Hands-on approach with individualized demonstration and instruction.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2203, CHEM 2213, or CHEM 2923) and (CHEM 2202 (may be taken concurrently), CHEM 2212 (may be taken concurrently), or CHEM 2922 (may be taken concurrently))

CHEM 2251. Organic Chemistry for Pre-Health Postbaccalaureates. 6 Credit Hours.

This course is typically offered in Fall.

This is a one-semester version of organic chemistry for post-baccalaureate students. It includes the chemistry of alkanes, alkenes, alkynes, alcohols, amines, alkyl halides, ethers, aromatic rings, aldehydes, ketones, carboxylic acids, esters, and amides. These topics will be covered with special consideration of their relevance to the health sciences. Note: To register for this course, students must satisfy the prerequisites or obtain permission from the program director.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in CHEM 1052 and CHEM 1054.

CHEM 2253. Organic Chemistry Lab for Pre-Health Postbaccalaureates. 1 Credit Hour.

This course is typically offered in Fall.

This is the laboratory component of a one-semester version of organic chemistry for post-baccalaureate students. It includes the chemistry of alkanes, alkenes, alkynes, alcohols, amines, alkyl halides, ethers, aromatic rings, aldehydes, ketones, carboxylic acids, esters, and amides. These topics will be covered with special consideration of their relevance to the health sciences. Note: To register for this course, students must satisfy the prerequisites or obtain permission from the program director.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in CHEM 2251 (may be taken concurrently) and CHEM 1054.

CHEM 2891. Introduction to Undergraduate Research. 1 Credit Hour.

This course is typically offered in Fall and Spring.

Study and research under supervision of a member of the Chemistry faculty. Open to sophomore chemistry and biochemistry majors, others with permission of the department. The student is expected to gain an introduction to research through participating in limited independent research (3-4 hours/week) and participating in group research activities. A group presentation is required, the content of which is to be determined in consultation with the Research Mentor. A final written report will be submitted to the faculty member, who will forward a copy to the Department's Undergraduate Research Coordinator. Students are responsible for arranging their program and submitting reports with lead-time sufficient that registration and grading can be accomplished normally. NOTE: For further information and details, contact the Undergraduate Research Coordinator. This course does not fulfill an advanced Chemistry course for the Chemistry B.A. or B.S. degree. This course is repeatable for credit.

Repeatability: This course may be repeated for additional credit.

CHEM 2921. Organic Chemistry for Honors I. 3 Credit Hours.

This course is typically offered in Fall.

Structure, synthesis, and reactivity of hydrocarbons and their simple derivatives. Principles of organic spectroscopy and stereochemistry. Introductory study of kinetics and reaction mechanisms. Presentation focused on topics of interest to the professional chemist. NOTE: This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032, CHEM 1042, or CHEM 1952)

CHEM 2922. Organic Chemistry for Honors II. 3 Credit Hours.

This course is typically offered in Spring.

Detailed examination of the more common functional groups and their reaction chemistry. Emphasis on development of organochemical reasoning powers through planning of multi-step syntheses and solution of structural problems by the combination of chemical and spectroscopic methods. Applications of organic chemistry to the chemical profession. NOTE: This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2201, CHEM 2211, or CHEM 2921)

CHEM 2923. Organic Honors Laboratory I. 1 Credit Hour.

This course is typically offered in Fall.

Introduction to organic chemical laboratory techniques, including spectroscopy and chromatography. Hands-on approach with individualized demonstration and instruction. NOTE: This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SA

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1034, CHEM 1044, or CHEM 1954) and (CHEM 2201 (may be taken concurrently), CHEM 2211 (may be taken concurrently), or CHEM 2921 (may be taken concurrently))

CHEM 2924. Organic Honors Laboratory II. 1 Credit Hour.

This course is typically offered in Spring.

Advanced organic chemical laboratory techniques, including spectroscopy and chromatography. Hands-on approach with individualized demonstration and instruction. NOTE: This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, SB

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2203, CHEM 2213, or CHEM 2923) and (CHEM 2202 (may be taken concurrently), CHEM 2212 (may be taken concurrently), or CHEM 2922 (may be taken concurrently))

CHEM 3001. Inorganic Chemistry. 3 Credit Hours.

Structure and bonding of inorganic compounds. Introduction to symmetry and group theory. Nomenclature. Descriptive chemistry of the main group elements. Introduction to transition metal chemistry and solid state materials. Mode: Three hours lecture and one hour recitation per week.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2201, CHEM 2211, or CHEM 2921)

CHEM 3091. Research Methods. 3 Credit Hours.

This course is typically offered in Spring.

Research Methods is required for all of the TUteach with Teaching majors. It is one of several content courses specially designed to meet the needs of future teachers. Sections meet two hours per week for non-traditional, interactive lectures and two hours per week for lab. The course is cross-listed in Biology, Chemistry, Earth and Environmental Science, and Physics. The goals of the course are (1) to provide students with the tools that scientists use to solve scientific problems; (2) to give students the opportunity to use these tools in a laboratory setting; (3) to make students aware of how scientists communicate with each other through peer-reviewed scientific literature; and (4) to enable students to understand how scientists develop new knowledge and insights, the most important of which are eventually presented in textbooks and taught in conventional science classes. Students design and carry out four independent inquiries, which they write up and present in the manner that is common in the scientific community. The inquiries incorporate mathematics and the various science disciplines, thus the team of instructors teaching this course have expertise in different disciplines and are available to supervise all students as they work on their inquiries in the lab. The combination of Research Methods and the TUteach course "Perspectives on Science and Mathematics" (Philosophy 2196) provides prospective science and mathematics teachers with an in-depth understanding of how the scientific enterprise works. NOTE: Chemistry 3091 is only available for major credit in the Chemistry with Teaching BS program.

College Restrictions: Must be enrolled in one of the following Colleges: Science & Technology.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of C- in (SCTC 1289 or SCTC 1389)

CHEM 3103. Analytical Chemistry. 3 Credit Hours.

This course is typically offered in Fall, Spring, and Summer I.

Introduction to the theory of instrumental analytical methods, with particular emphasis on equilibria and acid-base techniques. Application of statistics and error analysis to the design and execution of experiments, and writing and presenting scientific reports and papers. Note: Prior to Fall 2024, this course was titled "Techniques of Chemical Measurement I."

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032 or CHEM 1952), (CHEM 1034 or CHEM 1954), and (MATH 1042, MATH 1044, MATH 1942, MATH 1951, any MATH course numbered 2042 to 3080 (may be taken concurrently), 'Y' in MA07, 'Y' in MATW, 'Y' in CRMA09, 'Y' in CRMA10, or 'Y' in CRMA11)

CHEM 3105. Analytical Chemistry Lab. 1 Credit Hour.

This course is typically offered in Fall, Spring, and Summer I.

Introduction to the application of instrumental analytical methods, with particular emphasis on equilibria and acid-base techniques. Written scientific reports will require a quantitative analysis of collected data, including statistics and error analyses. Note: Prior to Fall 2024, this course was titled "Introduction to Chemical Research Techniques."

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032 or CHEM 1952), (CHEM 1034 or CHEM 1954), (MATH 1042, MATH 1044, MATH 1942, MATH 1951, any MATH course numbered 2042 to 3080 (may be taken concurrently), 'Y' in MA07, 'Y' in MATW, 'Y' in CRMA09, 'Y' in CRMA10, or 'Y' in CRMA11), and CHEM 3103 (may be taken concurrently)

CHEM 3301. Physical Chemistry Lecture I. 3 Credit Hours.

This course is typically offered in Fall and Spring.

Chemistry 3301 (0231) provides the foundation essential for most higher-level work in chemistry. Topics covered include thermodynamics, phase equilibria, chemical equilibria, kinetic theory of gases, chemical kinetics, and equilibrium electrochemistry.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032, CHEM 1042, or CHEM 1952), (MATH 2042 (may be taken concurrently), MATH 2043 (may be taken concurrently), MATH 2943 (may be taken concurrently), any MATH course numbered 3043 to 3044 (may be taken concurrently), any MATH course numbered 3137 to 3142 (may be taken concurrently), or any MATH course numbered 4051 to 4063 (may be taken concurrently)), and (PHYS 1062 (may be taken concurrently), PHYS 2022 (may be taken concurrently), PHYS 2922 (may be taken concurrently), any PHYS course numbered 2101 to 2701 (may be taken concurrently), any PHYS course numbered 3101 to 3701 (may be taken concurrently), or any PHYS course numbered 4101 to 4796 (may be taken concurrently))

CHEM 3302. Physical Chemistry Lecture II. 3 Credit Hours.

This course is typically offered in Fall and Spring.

An introduction to quantum mechanics and spectroscopy. NOTE: Although it is recommended that physical chemistry courses be taken in sequence [i.e., 3301 (0231) followed by 3302 (0232)], this course may be taken prior to Chemistry 3301 (0231).

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1032, CHEM 1042, or CHEM 1952), (MATH 2042 (may be taken concurrently), MATH 2043 (may be taken concurrently), MATH 2943 (may be taken concurrently), any MATH course numbered 3043 to 3044 (may be taken concurrently), any MATH course numbered 3137 to 3142 (may be taken concurrently), or any MATH course numbered 4051 to 4063 (may be taken concurrently)), and (PHYS 1062 (may be taken concurrently), PHYS 2022 (may be taken concurrently), PHYS 2922 (may be taken concurrently), any PHYS course numbered 2101 to 2701 (may be taken concurrently), any PHYS course numbered 3101 to 3701 (may be taken concurrently), or any PHYS course numbered 4101 to 4796 (may be taken concurrently))

CHEM 3303. Physical Chemistry Laboratory I. 2 Credit Hours.

This course is typically offered in Fall and Spring.

A laboratory-based exploration of the fundamental physical and chemical principles involved in thermodynamics, chemical equilibria, colligative properties, and electrochemistry. The material complements topics covered in CHEM 3301. Special emphasis is placed on physical measurements followed by computer-aided analysis of data and errors.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3103, CHEM 3105, and CHEM 3301.

CHEM 3397. Physical Chemistry Laboratory I. 2 Credit Hours.

This course is typically offered in Fall and Spring.

A laboratory-based exploration of the fundamental physical and chemical principles involved in thermodynamics, chemical equilibria, colligative properties, and electrochemistry. The material complements topics covered in CHEM 3301. Special emphasis is placed on physical measurements followed by computer-aided analysis of data and errors. This writing-intensive course gives the student experience in generating technical reports as preparation for a professional career in Chemistry. NOTE: Capstone writing course.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 3103, CHEM 3105, and CHEM 3301)

CHEM 3398. Physical Chemistry Laboratory II. 2 Credit Hours.

This course is typically offered in Fall and Spring.

A laboratory-based exploration of the fundamental physical and chemical principles involved in quantum mechanics, spectroscopy, and chemical kinetics. The material complements topics covered in CHEM 3302. Special emphasis is placed on physical measurements followed by computer-aided analysis of data and errors. This writing-intensive course gives the student experience in generating technical reports as preparation for a professional career in Chemistry. NOTE: Capstone writing course.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 3103, CHEM 3105, and CHEM 3302)

CHEM 3401. Applications of Biochemistry. 3 Credit Hours.

This course provides a comprehensive introduction to biochemical concepts with an emphasis on application and relevance to health and medicine. Topics in the course will provide a strong background and foundation for students interested in pre-professional health programs. This course will satisfy the biochemistry requirement for the American Chemical Society certified degree in chemistry. Biochemistry majors must take CHEM 4401 instead of this course.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2202, CHEM 2212, or CHEM 2922)

CHEM 3405. Physical Chemistry of Biomolecules. 3 Credit Hours.

CHEM 3405 is a lecture/recitation based survey course that covers those aspects of physical chemistry of use to biochemists in understanding the physical properties of biologically significant molecules and structures. Topics to be covered include thermodynamics, colligative properties of matter, electrolytes, enzyme kinetics, quantum theory, and spectroscopy. Note: Not for Chemistry majors.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042 or MATH 1942), (PHYS 1062 (may be taken concurrently), PHYS 1962 (may be taken concurrently), PHYS 2022 (may be taken concurrently), or PHYS 2922 (may be taken concurrently)), and CHEM 4401 (may be taken concurrently)

CHEM 3881. Cooperative Research. 2 to 4 Credit Hours.

This course is typically offered in Fall, Spring, Summer I, and Summer II.

Independent study and research at Temple University outside of the Chemistry Department or at an off-campus laboratory facility under joint supervision of a member of the Temple Chemistry faculty and a Research Mentor at the laboratory facility. The class also meets one hour per week with the Undergraduate Research Coordinator to discuss report writing, searching the scientific literature, and proper research scholarship. Open to junior and senior chemistry and biochemistry majors, others with departmental approval. Credit may be offered for research during full-time off-campus employment. A final written report will be evaluated and endorsed by the research mentor and forwarded to the Department's Undergraduate Research Coordinator for final grade assignment. Students are responsible for arranging their programs and submitting reports with sufficient lead-time that registration and grading can be accomplished normally. NOTE: For further information and details, contact the Undergraduate Research Coordinator. CHEM 3881 can count as 1 of the 3 advanced laboratory courses required for the degree to be certified by the American Chemical Society. It will fulfill an Advanced Science elective for the Chemistry B.A. or B.S. degree. It will not fulfill an Advanced Chemistry elective for either Chemistry degree. Biochemistry majors may use CHEM 3881 as the first of two research courses towards satisfying one Biochemistry major elective.

Repeatability: This course may not be repeated for additional credits.

CHEM 3891. Undergraduate Research. 2 to 4 Credit Hours.

This course is typically offered in Fall, Spring, Summer I, and Summer II.

Independent study and research under the supervision of a member of the Chemistry faculty. The class also meets one hour per week with the Undergraduate Research Coordinator to discuss report writing, searching the scientific literature, and proper research scholarship. Open to junior and senior chemistry and biochemistry majors, others with permission of the department. A final written report will be evaluated by the faculty mentor and forwarded to the Department's Undergraduate Research Coordinator for final grade assignment. Students are responsible for arranging their program and submitting reports with sufficient lead-time that registration and grading can be accomplished normally. NOTE: For further information and details, contact the Undergraduate Research Coordinator. CHEM 3891 can count as 1 of the 3 advanced laboratory courses required for the degree to be certified by the American Chemical Society. It will fulfill an Advanced Science elective for the Chemistry B.A. or B.S. degree. It will not fulfill an Advanced Chemistry elective for the Chemistry B.A. or B.S. degree. Biochemistry majors may use CHEM 3891 as the first of two research courses towards satisfying one Biochemistry major elective.

Repeatability: This course may not be repeated for additional credits.

CHEM 4002. Advanced Inorganic Chemistry. 3 Credit Hours.

This course is not offered every year.

Group theory and its applications to chemical systems. Molecular orbital theory and spectroscopy. Descriptive chemistry of transition metal and organometallic compounds. Mode: Three hours lecture and one hour recitation per week.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 3001 or CHEM 4001) and (CHEM 3301 or CHEM 3302)

CHEM 4003. Inorganic Synthesis. 4 Credit Hours.

This course is typically offered in Fall and Spring.

Introduction to preparative techniques and spectroscopic techniques used in contemporary inorganic chemistry. NOTE: This course can count as one of the three advanced laboratory courses required for the degree to be certified by the American Chemical Society. Mode: One hour lecture and six hours laboratory per week.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 3001 or CHEM 4001) and (CHEM 3301 or CHEM 3302)

CHEM 4004. Crystallography and Diffraction. 4 Credit Hours.

This course is typically offered in Spring.

Students will learn the theory and practice of crystal structure determination by the method of single-crystal X-ray diffraction. Students will become independently competent in each stage of the crystal structure data collection, solution, and refinement processes, and will understand the theory behind each stage, as well as how to overcome common pitfalls. NOTE: This course can count as one of the three advanced laboratory courses required for the degree to be certified by the American Chemical Society. Mode: Three hours lecture and three hours laboratory per week.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 1031 or CHEM 1951) and (PHYS 1062, PHYS 1962, PHYS 2022, or PHYS 2922)

CHEM 4103. Instrumental Design. 4 Credit Hours.

This course is typically offered in Fall.

This course covers method development for the analysis of complex organic mixtures. The analytical techniques detailed are High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), and other appropriate chromatographic methodologies. NOTE: This course can count as one of the three advanced laboratory courses required for the degree to be accredited by the American Chemical Society.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3103, CHEM 3105, and CHEM 4196 (may be taken concurrently)

CHEM 4107. Drug Analysis. 4 Credit Hours.

This course is not offered every year.

Analytical techniques with specific applications to drug substances.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3103, CHEM 3105, CHEM 3301, and CHEM 4196.

CHEM 4108. Investigative Chemistry. 4 Credit Hours.

This course is typically offered in Spring.

This course will challenge students to perform chemical analyses on a variety of samples that may be considered as evidence. Students will be instructed in methodology and method validation. An understanding of data statistics and representation of data through use of spreadsheets will be emphasized. This course will introduce students to modern chemical instrumentation and techniques as applied to forensic issues.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3103, CHEM 3105, and CHEM 4196.

CHEM 4196. Instrumental Analysis. 5 Credit Hours.

This course is typically offered in Fall and Spring.

This course provides an introduction to modern applications of chromatography and spectroscopy. Laboratory assignments involve quantitative and qualitative analyses of inorganic and organic molecules. Instrumentation design, operating principles, and theory will be presented as they apply to uv-vis, nmr, fluorescence, epr, aa, ae, gc, gc-ms, gpc, and hplc. Note: Prior to Fall 2024, this course was titled "Techniques of Chemical Measurement II." Note: Capstone writing course.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3103 and CHEM 3105.

CHEM 4201. Organic Structure and Mechanisms. 3 Credit Hours.

This course is typically offered in Fall.

A problem-oriented course in organic structure, stereochemistry, and reaction mechanisms. Introduction to efficient retrieval of information from the organochemical literature. Simple molecular orbital and HOMO/LUMO theory.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2202, CHEM 2212, or CHEM 2922)

CHEM 4202. Organic Synthesis Methodology. 3 Credit Hours.

This course is typically offered in Spring.

Modern approaches to efficiently designed multi-step syntheses of important compounds. Retrosynthetic analysis, synthons, chirons, and protecting groups. Evaluation and appreciation of landmark achievements in the field.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2202, CHEM 2212, or CHEM 2922)

CHEM 4207. Synthesis and Identification of Organic and Medicinal Compounds. 4 Credit Hours.

This course is typically offered in the Spring.

This course emphasizes the preparation of organic and medicinal compounds using modern chemical methods. Literature sources and spectroscopic methods are extensively used. Students learn the safe use of air sensitive reagents, the methods for purification, and the design of multistep syntheses. The environmental impact of method choice is addressed throughout the course. NOTE: This course can count toward the American Chemical Society certified BS degree.

Course Attributes: SI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2202, CHEM 2212, or CHEM 2922) and (CHEM 2204, CHEM 2214, or CHEM 2924)

CHEM 4301. Advanced Physical Chemistry. 3 Credit Hours.

This course will cover advanced topics in Physical Chemistry. A main focus will be on statistical thermodynamics, which links the microscopic molecular properties of matter and its bulk thermodynamic properties. Other topics to be covered are chemical kinetics, reaction dynamics, and computational chemistry. Prior basic knowledge in Thermodynamics (CHEM 3301) and Quantum Mechanics (CHEM 3302) is required.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3301 and CHEM 3302.

CHEM 4396. Physical Chemistry Laboratory. 4 Credit Hours.

This course is typically offered in Fall and Spring.

A laboratory study of the fundamental physical and chemical principles involved in molecular spectroscopy, thermodynamics, and chemical kinetics, with particular emphasis on the techniques of physical measurement and the presentation of coherent laboratory reports. NOTE: Capstone writing course.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 3103, CHEM 3105, (CHEM 3301 or CHEM 3302), and (CHEM 3301 (may be taken concurrently) or CHEM 3302 (may be taken concurrently))

CHEM 4401. Biochemistry I. 3 Credit Hours.

This course is typically offered in Fall and Spring.

Emphasis on structure/function relationships in proteins and nucleic acids. Kinetics and catalytic mechanisms of enzymes. Replication and genetic manipulation of DNA. NOTE: This course is required for the degree to be certified by the American Chemical Society.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2202, CHEM 2212, or CHEM 2922) and CHEM 3103 (may be taken concurrently)

CHEM 4496. Research Techniques in Biochemistry. 4 Credit Hours.

This course will be offered in Fall and Spring.

Laboratory instruction in techniques used to investigate biochemical problems. Techniques include spectrophotometry, various types of electrophoresis, separation of macromolecules, two-dimensional protein separation, affinity chromatography, isolation of plasmid DNA, Western Blot, immunoassay, enzyme kinetics, and radioisotope techniques. Students will be given a small research project. This is a writing intensive course.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in CHEM 4401.

CHEM 4503. Introduction to Polymer Chemistry. 4 Credit Hours.

This course is typically offered in Fall.

Polymers are ubiquitous in many new (scaffolds for tissue engineering, hip replacements) and old (textiles, engineering resins, flocculants) applications, and are often used in composites with inorganic materials. In order to better understand the use and novel developments of polymers, this course will provide the fundamentals of synthesis, polymer structure/property relationships, and characterization methods. There is a laboratory component to the course that will cover molecular weight and phase transition methods.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (CHEM 2202, CHEM 2212, or CHEM 2922) and CHEM 3301.

CHEM 4881. Cooperative Research. 1 to 3 Credit Hour.

This course is typically offered in Fall, Spring, Summer I, and Summer II.

Independent study and research at Temple University outside of the Chemistry Department or at an off-campus laboratory facility under joint supervision of a member of the Temple Chemistry faculty and a Research Mentor at the laboratory facility, to be taken after a minimum grade of C- in CHEM 3881 or CHEM 3891. Open to senior chemistry and biochemistry majors, others with departmental approval. Credit may be offered for research during full-time off-campus employment. A final written report will be evaluated and endorsed by the research mentor and forwarded to the Department's Undergraduate Research Coordinator for final grade assignment. Students are responsible for arranging their programs and submitting reports with lead-time sufficient that registration and grading can be accomplished normally. NOTE: For further information and details, contact the Undergraduate Research Coordinator. CHEM 4881 will not count as an advanced laboratory course required for the degree to be certified by the American Chemical Society and/or as an Advanced Science elective for the Chemistry B.A. or B.S. degree. CHEM 4881 will not fulfill an Advanced Chemistry elective for the Chemistry B.A. or B.S. degree. Biochemistry majors may use CHEM 4881 to satisfy one of the two major course electives.

Repeatability: This course may be repeated for additional credit.

CHEM 4891. Undergraduate Research. 1 to 3 Credit Hour.

This course is typically offered in Fall, Spring, Summer I, and Summer II.

Independent study and research under supervision of a member of the Chemistry faculty, to be taken after a minimum grade of C- in CHEM 3881 or CHEM 3891. Open to senior chemistry and biochemistry majors, others with the permission of the department. A final written report will be evaluated by the faculty mentor and forwarded to the Department's Undergraduate Research Coordinator for final grade assignment. Students are responsible for arranging their program and submitting reports with sufficient lead-time that registration and grading can be accomplished normally. NOTE: For further information and details, contact the Undergraduate Research Coordinator. CHEM 4891 will not count as an advanced laboratory course required for the degree to be certified by the American Chemical Society and/or as an Advanced Science elective for the Chemistry B.A. or B.S. degree. CHEM 4891 will not fulfill an Advanced Chemistry elective for the Chemistry B.A. or B.S. degree. Biochemistry majors may use CHEM 4891 to satisfy one of the two major course electives.

Repeatability: This course may be repeated for additional credit.

CHEM 5001. Advanced Inorganic Chemistry I. 3 Credit Hours.

Group theory and its applications to chemical systems. Molecular orbital theory and spectroscopy. Descriptive chemistry of transition metal and organometallic compounds.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5005. Organometallic Chemistry. 3 Credit Hours.

A survey of the chemistry of organic compounds of the main and transition elements, with emphasis on their reactions and applications.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5102. Data Analysis and Evidence. 2 Credit Hours.

Forensic chemistry involves the forensic application of analytical chemistry theories, techniques and instrumentation to the analysis of controlled substances, fire debris evidence, explosives, and other trace evidence/chemical unknown materials. This course will cover those concepts relevant to the field of forensic chemistry including chain of custody, the theory and practical applications of the uncertainty of measurement and propagation of error. Students will also learn the classifications and unique physical and chemical characteristics of forensic chemistry evidence and investigate the physical and chemical characteristics of this evidence through the use of chemical, microscopic and instrumental techniques. The chemical characteristics of explosive materials as well as the analytical techniques used to analyze these samples will also be covered.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5103. Advanced Instrumental Methods. 3 Credit Hours.

Recent developments in electrochemical and electroanalytical techniques, including voltammetric and potentiostatic procedures and the basics of instrumental design. Applications to organic chemistry, trace analysis, chromatographic detectors, and electrokinetics discussed.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5107. Drug Analysis. 4 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5108. Investigative Chemistry. 4 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5201. Physical Methods in Organic Chemistry. 3 Credit Hours.

Principles and applications of important physical and spectroscopic methods; IR, UV, NMR, MS, ESR, ORD, and CD in structure determination.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5202. Organic Reaction Mechanisms. 3 Credit Hours.

This course is an introductory overview of organic structure and most common organic reaction mechanisms.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5205. Organic Syntheses. 3 Credit Hours.

Scope and limitations of modern synthetic methods, including silicon reagents, organometallic and radical chemistry.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5301. Quantum Chemistry. 3 Credit Hours.

Introduction to quantum mechanics and its application to chemical systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5302. Statistical Thermodynamics. 3 Credit Hours.

The basic concept of statistical mechanical ensembles and their application.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5304. Nanomaterials Chemistry and Physics. 3 Credit Hours.

This course will cover the key chemical/physical properties of nanomaterials as well as nanomaterials characterization and synthesis for graduate students. The goal of this class is to help students get familiar to the important concepts associated with the confined dimensionality in nanomaterials and apply these concepts to understand unique electronic/optical properties of nanomaterials and the thermodynamics/kinetics of forming nanomaterials. The course is organized with four modules: 1) Introduction to Nanoscience - Physical and Chemical Concepts, 2) Characterization of Materials at Nanoscale, 3) Fabrication of Nanostructures and Nanomaterials, and 4) Case Study of Specific Nanomaterials.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5305. Chemical Kinetics. 3 Credit Hours.

A study of the dynamics of chemical reactions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5358. Cellular/Molecular Neuroscience. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5401. Biochemistry I. 3 Credit Hours.

A survey of the biological macromolecules (proteins, nucleic acids, carbohydrates, and lipids) correlating their structures with their chemical properties and biological functions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5402. Chemical Biology. 3 Credit Hours.

This course will focus on the interactions between chemicals and biomolecules, with an eye on how to search, create, and modify molecules that can be either probes to understand, or therapeutic drugs to treat human diseases. Modern medicinal chemistry and biotechnologies will be covered to elucidate how chemistry can be used to perturb the biomolecules' structure and function, topics not typically studied in an undergraduate organic chemistry or biochemistry course. An advanced level of study in chemical biology can only be attained by a critical reading of scientific literature, and this course will consist of both lectures and student presentations of literature research.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5412. Structural Bioinformatics II. 3 Credit Hours.

This course provides an introduction to structural bioinformatics, with focus on understanding three dimensional structures of biological macromolecules. Topics covered include: an overview of macromolecular structure determination, introduction to molecular modeling theory and the application of computational modelling in structure based drug design. The course also offers practical training on the application of molecular modelling methods for understanding structural biology and in rational drug discovery.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B- in BIOL 5411.

CHEM 5505. Advanced Polymer Structure and Properties. 3 Credit Hours.

Polymers are ubiquitous in many new (scaffolds for tissue engineering, hip replacements) and old (textiles, engineering resins, flocculants) applications, and are often used in composites with inorganic materials. In order to better understand the use and novel developments of polymers, this course will provide the fundamentals of synthesis, polymer structure/property relationships, and characterization methods.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5701. Teaching of Chemistry. 0 to 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 5901. Responsibility and Ethics in Chemical Research. 1 Credit Hour.

The primary goal of this course is to educate graduate students in the ethical and responsible practices of scientific research. The course is designed to meet the requirements of both the NIH and NSF for training in responsible conduct of research (RCR). As an independent scientific researcher it is critical to have an understanding on what constitutes ethical scientific practices both in the laboratory and in professional interactions with colleagues. This course will be based on student-led presentations and case study discussions in order to understand the real world applications of these issues.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8000. Special Topics in Inorganic Chemistry. 3 Credit Hours.

A survey of a topic chosen by the instructor. Topics could include bioinorganic chemistry, organometallic chemistry, solid state and materials chemistry, and catalysis.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 8001. Leadership, Law and Ethics in Forensic Science. 3 Credit Hours.

This course will provide the students with an introduction to the American criminal justice system, explain the role of the forensic scientist in the criminal justice system, and discuss theoretical and practical applications of forensic science laboratory management. Students will learn successful leadership styles and discuss topics relating to ethical behavior, quality measures including quality control and quality assurance, communication and privacy issues relating to forensic science as well as resource management. Through discussion and analysis of the U.S. Constitution, the Pennsylvania Constitution, Federal (and State) Rules of Criminal Procedure, and Federal (and State) Rules of Evidence with particular emphasis on case law, students will develop a practical understanding of modern criminal jurisprudence. Special emphasis and consideration will be given to the ethical obligations of criminal justice practitioners, including judges, prosecutors, defense attorneys, law enforcement officers and expert witnesses.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8002. Practical X-Ray Diffraction. 3 Credit Hours.

Students will learn the theory and practice of crystal structure determination by the method of single-crystal X-ray diffraction. Students will become independently competent in each stage of the crystal structure data collection, solution, and refinement processes, and will understand the theory behind each stage, as well as how to overcome common pitfalls. The course features expanded topics over the undergraduate version of the course (CHEM 4004), including how to treat common crystallographic pitfalls in solution structure and refinement. These include disorder, twinning, space group ambiguity, and misplaced origin errors. Mode: 3 hours of lecture and/or lab per week.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8007. Biotransformation of Drugs and Xenobiotics. 3 Credit Hours.

Drug Metabolism is an essential component of forensic sciences. This course is important for a thorough understanding of the basic concepts of absorption, distribution, elimination, excretion, and in particular xenobiotic disposition. The discipline of biotransformation continues to evolve as it adapts to new scientific discoveries bringing new opportunities for forensic science research. This course is designed to teach the advances in drug metabolism.

Level Registration Restrictions: May not be enrolled in one of the following Levels: Undergraduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8107. Advanced Forensic Chemistry. 3 Credit Hours.

Forensic chemistry involves the forensic application of analytical chemistry theories, techniques and instrumentation to the analysis of controlled substances, fire debris evidence, explosives, and other trace evidence/chemical unknown materials. This course will cover those concepts relevant to the field of forensic chemistry including chain of custody, the theory and practical applications of the uncertainty of measurement and propagation of error. Students will also learn the classifications and unique physical and chemical characteristics of forensic chemistry evidence and investigate the physical and chemical characteristics of this evidence through the use of chemical, microscopic and instrumental techniques. The chemical characteristics of explosive materials as well as the analytical techniques used to analyze these samples will also be covered.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of B+ in CHEM 5102.

CHEM 8111. Forensic Toxicology. 3 Credit Hours.

Students in this class learn to apply fundamental principles of toxicology (e.g., dose response, toxicokinetics, pharmacodynamics, route of exposure) to understand common drugs and chemical exposures that often are involved in forensic cases. The course teaches toxicology from three different but overlapping approaches: Common Drugs and chemical toxicants (e.g., alcohol, cannabis, opioids, other drugs of abuse, metals, gases), Mechanisms of Toxicity (e.g., oxidative stress, cell death) and Organ System Toxicity (e.g., neurotoxicity, liver toxicity, etc.). The course makes use of real world case examples thereby allowing students to apply theory to practice.

Level Registration Restrictions: May not be enrolled in one of the following Levels: Undergraduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8200. Special Topics in Organic Chemistry. 3 Credit Hours.

Advanced lecture course; subject matter varies from semester to semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 8201. The Chemistry of Natural Products. 3 Credit Hours.

Biogenetic classification, classical and modern synthetic approaches to polyketides, steroids, terpenes, and alkaloids.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8205. Heterocyclic Chemistry. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8210. Special Topics in Organic Chemistry. 3 Credit Hours.

Advanced lecture course; subject matter varies from semester to semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 8300. Special Topics in Physical Chemistry. 3 Credit Hours.

Advanced lecture course, subject matter varies from semester to semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 8301. Molecular Spectroscopy. 3 Credit Hours.

Absorption, emission and scattering of light by molecular system. Discussion of basic principles and experimental techniques.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8302. Computational Chemistry. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8303. Modern Meth in Exp Chem. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8310. Special Topics in Analytical Chemistry. 3 Credit Hours.

Advanced lecture course, subject matter varies from semester to semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 8400. Special Topics in Biochemistry. 3 Credit Hours.

Advanced lecture course; subject matter varies from semester to semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 8401. Bioinorganic Chemistry. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8501. High Polymer Chemistry. 3 Credit Hours.

Introduction to the important theoretical and practical aspects of high polymer chemistry.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8601. Analytical Separations. 3 Credit Hours.

Theory and practice of modern separation methods with emphasis on chromatographic and electrophoretic techniques.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

CHEM 8985. Teaching in Higher Ed:Phys Sci. 1 to 3 Credit Hour.

Teaching in Higher Education: Physical Sciences. This course focuses on learning theory and the best teaching practices, with the aim of preparing students for effective higher education teaching.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9300. Seminar in Physical Chemistry. 1 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9800. Seminar in Forensic Chemistry. 1 Credit Hour.

Wide-ranging introduction to key areas and "hot topics" in forensic science, as presented by a series of guest lectures by leading practitioners in the field.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9900. Seminar. 2 Credit Hours.

Formal presentation of research topics by graduate students. Regular attendance required of all graduate students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9901. Original Research Proposal Preparation. 1 Credit Hour.

This class affords guidance on developing the original research proposal, a required component for advancing to PhD candidacy in the Department of Chemistry.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in CHEM 9900.

CHEM 9991. Graduate Research Projects. 1 to 6 Credit Hour.

Short-term, limited research project or laboratory project in the field. The course is for doctoral or master's students, including PSM, MA or MS. This class will not confer full-time program status unless nine credits are taken.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course is required for students who are preparing for the preliminary or candidacy examination. Students should enroll after coursework is completed or when preparing for the candidacy exam until the time that the preliminary or candidacy examination is completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. All students must complete a minimum of one credit of this course. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9995. Capstone Project. 1 to 6 Credit Hour.

Capstone project for master's students including students in PSM, MA or MS. This class will provide full-time status. Students in PSM programs need to register for at least one credit of this course to fulfill program requirements. Additional credits may be required for specific programs. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Degree Restrictions: Must be enrolled in one of the following Degrees: Master of Arts, Master of Science, Prof Science Masters.

Repeatability: This course may be repeated for additional credit.

CHEM 9996. Master's Thesis Research. 1 to 6 Credit Hour.

Course for master's thesis research. Only intended for students in thesis bearing master's programs. A minimum of one credit is required. This course will confer full-time status at the minimum credit hour registration limit of one credit.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

CHEM 9998. Pre-Dissertation Research / Elevation to Candidacy. 1 to 6 Credit Hour.

This course is intended for students who are performing research prior to candidacy. Students can register for this course after required courses are completed. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must be registered for this course during the semester that they are to be elevated to candidacy examination. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Field of Study Restrictions: Must be enrolled in one of the following Fields of study: Chemistry.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Science & Technology.

Repeatability: This course may be repeated for additional credit.

CHEM 9999. Dissertation Research. 1 to 6 Credit Hour.

The course is for Ph.D. students who have been elevated to candidacy. During the course of their candidacy students must complete a minimum of two credits of dissertation research. This course will confer full-time status at the minimum credit hour registration limit of one credit. Students must complete a total of 6 credit hours of 9994, 9998 and 9999.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.