CHEMISTRY (Div III)

Chair: Professor Sarah Goh

- Anthony J. Carrasquillo, Assistant Professor of Chemistry; on leave 2021-2022
- Amy Gehring, Philip and Dorothy Schein Professor of Chemistry; on leave Fall 2021
- Christopher Goh, Professor of Chemistry
- Sarah L. Goh, Chair and Professor of Chemistry
- Kerry-Ann Green, Assistant Professor of Chemistry
- Katie M. Hart, Assistant Professor of Chemistry; on leave 2021-2022
- Jenna MacIntire, Lecturer in Chemistry
- Amnon G Ortoll-Bloch, Postdoctoral Fellow in Chemistry
- Lee Y. Park, William R. Kenan, Jr. Professor of Chemistry
- Enrique Peacock-López, Halford R Clark Professor of Natural Sciences; on leave Fall 2021
- Bob Rawle, Assistant Professor of Chemistry; on leave 2021-2022
- Jennifer K. Rosenthal, Instructor in Chemistry
- Thomas E. Smith, Professor of Chemistry
- Laura R. Strauch, Lecturer in Chemistry
- John W. Thoman, J. Hodge Markgraf Professor of Chemistry; on leave Spring 2022
- Ben W. Thuronyi, Assistant Professor of Chemistry
- Amanda K. Turek, Assistant Professor of Chemistry

MAJOR

Through a variety of individual courses and sequential programs, the department provides an opportunity for students to explore the nature and significance of chemistry, an area of important achievement in our quest for knowledge about ourselves and the world around us. The student of chemistry is able to become aware of the special viewpoint of chemists, the general nature of chemical investigation, some of its important results, how these results are expressed, and something of their significance within the fields of science and in the area of human endeavor as a whole. The Chemistry major provides excellent preparation for graduate study in chemistry, biochemistry, chemical engineering, environmental science, materials science, medicine, and the medical sciences.

A major in chemistry can be achieved in several ways, preferably beginning in the student's first year at Williams, but also beginning in the sophomore year. Building on a foundation in general chemistry, organic chemistry, and physical chemistry, a student elects additional advanced courses to complete a major that is consistent with their background in other sciences, interests, and goals. A student's program might emphasize biochemistry, organic chemistry, physical chemistry, or inorganic chemistry, with additional courses available in analytical chemistry, environmental science, and materials science. Students considering a major in chemistry should consult with a member of the department as early as possible in order to plan a program which best suits their interests and abilities and which makes full use of their previous preparation.

All students begin their study in the department with either Chemistry 151, 153, or 155. Placement at the introductory level is based upon performance on the departmental placement test results and consultation with the chair; results of the College Board Advanced Placement Test or the International Baccalaureate Exam are also taken into account.

The first year is completed with Chemistry 156. In the second year at the introductory level, students take Chemistry 251 (or 255) and Chemistry 256 (those students who complete 155 are exempted from 256). Completion of a Chemistry major requires either nine semester chemistry courses or eight semester chemistry courses plus two approved courses from among the following: Biology 101; Computer Science 134; Mathematics 130, 140, 150, 151; Physics 131, 141; or any courses in these departments for which the approved courses are prerequisites. CHEM 155 counts for two courses toward the major, but a single course toward graduation credit. For the Class of 2022: starting at the 300 level, at least TWO of the courses taken must have a laboratory component. For the Class of 2023, Class of 2024, and Class of 2025: starting at the 300 level, at least THREE of the courses taken must have a laboratory component. For all majors, at least one must be selected from Chemistry 361, 364, 366, or 367. (The specific course elected, in consultation with the chair or major advisor, will depend on the student's future plans.) In addition, the department has a number of "Independent Research Courses" which, while they do not count toward completion of the major, provide a unique opportunity to pursue an independent research project under the direction of a faculty member.

Foundational Courses

First Year

Fall: 151,153 or 155 Gateway courses

Spring: 156 Organic Chemistry: Introductory Level

Second Year

Fall: 251 (or 255) Organic Chemistry: Intermediate Level

Spring: 256 Advanced Chemical Concepts (or 300-level if completed 155)

Elective Courses

319 Integrative Bioinformatics, Genomics, and Proteomics Lab

321 Biochemistry I-Structure and Function of Biological Molecules

322 Biochemistry II-Metabolism

324 Enzyme Kinetics and Reaction Mechanisms

326 Chemical and Synthetic Biology

335 Inorganic/Organometallic Chemistry

336 Materials Chemistry

338 Bioinorganic Chemistry: Metals in Living Systems

341 Toxicology and Cancer

342 Synthetic Organic Chemistry

343 Medicinal Chemistry

344 Physical Organic Chemistry

348 Polymer Chemistry

361 Quantum Chemistry and Chemical Dynamics

364 Instrumental Methods of Analysis

366 Thermodynamics and Statistical Mechanics

367 Biophysical Chemistry

368T Computational Chemistry and Molecular Spectroscopy

373 Environmental Organic Chemistry

Independent Research Courses

393-W31-394 Junior Research and Thesis

397, 398 Independent Study, for Juniors

493-W31-494 Senior Research and Thesis

497, 498 Independent Study, for Seniors

For the purpose of assisting students in selecting a program consistent with their interests and possible continuation of their studies at the graduate level, the following groupings of electives and faculty advisors are suggested. However, a case can be made for selecting courses from the different groups.

Biochemistry: Chemistry 321, Chemistry 322, Chemistry 324, Chemistry 326, Chemistry 341, Chemistry 364, Chemistry 367. Students interested in biochemistry should consult with Professors Gehring, Hart, Rawle, or Thuronyi.

Organic Chemistry: Chemistry 341, Chemistry 342, Chemistry 343, Chemistry 344, Chemistry 348, Chemistry 364, Chemistry 361, Chemistry 366, Chemistry 373. Students interested in organic chemistry should consult with Professors S. Goh, Green, Smith, Thuronyi, or Turek.

Physical and Inorganic Chemistry: Chemistry 335, Chemistry 336, Chemistry 338, Chemistry 361, Chemistry 364, Chemistry 366, Chemistry 368T. Students interested in physical chemistry should consult with Professors Carrasquillo, Peacock-López, or Thoman. Students interested in inorganic chemistry should consult with Professors C. Goh, Green, or Park. Students interested in materials science should consult with Professors S. Goh or Park. Students interested in environmental chemistry should consult with Professor Carrasquillo.

While any accepted route through the major would permit a student to proceed to graduate study in chemistry, four electives should be considered a minimum, and at least a semester of research is strongly recommended.

The department's curriculum is approved by the American Chemical Society (A.C.S.), a professional body of academic, industrial, and research chemists. The A.C.S. suggests the following courses for someone considering graduate study or work in chemistry or a related area: 151 (153 or 155), 156, 251 (255), 256, 321, 335, 364, 361 (366 or 367) and at least 3 courses (all of which must have a laboratory component or at least one must be a research course of 393 or above) from our remaining upper level electives: 319, 322, 324, 326, 336, 341, 342, 343, 344T, 348, 361, 366, 367, 368T, 393, 394, 397, 398, 493, 494, 497, 498, BIMO 401. Students are strongly encouraged (though not required) to pursue independent research in some form. In addition, students have also completed 2 semesters of calculus and 2 semesters of physics. Students completing these requirement can be designated Certified A.C.S. Majors.

BIOCHEMISTRY AND MOLECULAR BIOLOGY (BIMO)

Students interested in Biochemistry and Molecular Biology should consult with the general statement under the Biochemistry and Molecular Biology Program (BIMO) in the Courses of Instruction. Students interested in completing the BIMO program are also encouraged to complete the biochemistry courses within the chemistry major by taking 321, 322, 324, and 367 in addition to the first and second year required courses.

BIOINFORMATICS, GENOMICS, AND PROTEOMICS (BiGP)

Students interested in Bioinformatics, Genomics, and Proteomics should consult the general statement under Bioinformatics, Genomics, and Proteomics in the Courses of Instruction. Students interested in these areas are also encouraged to complete the biochemistry courses within the chemistry major by taking 319, 321, 322, 324 and 367 in addition to the first and second year required courses.

THE DEGREE WITH HONORS IN CHEMISTRY

The degree with honors in Chemistry provides students with an opportunity to undertake an independent research project under the supervision of a faculty member, and to report on the nature of the work in two short oral presentations and in a written thesis.

Chemistry majors who are candidates for the degree with honors take the following in addition to a major outlined above:

Chemistry 493-W31-494 Senior Research and Thesis

The principal considerations in admitting a student to a program of independent research are mastery of fundamental materials and skills, ability to pursue independent study successfully, and demonstrated student interest and motivation. In addition, to enroll in these courses leading to a degree with honors, a student must have at least a B- average in all chemistry courses or the permission of the chair. At the end of the first semester of the senior year, the department reviews the student's progress and determines whether the student is a candidate for a degree with honors. The designation of a degree with honors in Chemistry or a degree with highest honors in Chemistry is based primarily on a departmental evaluation of the accomplishments in these courses and on the quality of the thesis. Completion of the research project in a satisfactory manner and preparation of a well-written thesis usually results in a degree with honors. In cases where a student has demonstrated unusual commitment and initiative resulting in an outstanding thesis based on original results, combined with a strong record in all of their chemistry courses, the department may elect to award a degree with highest honors in Chemistry.

EXCHANGE AND TRANSFER STUDENTS

Students from other institutions wishing to register for courses in chemistry involving college-level prerequisites should do so in person with a member of the Chemistry Department. Registration should take place by appointment during the spring semester prior to the academic year in which courses are to be taken. Students are requested to have with them transcripts of the relevant previous college work.

COURSES FOR NON-MAJORS WITH NO PREREQUISITES

Students with principal interests outside of the sciences may extend a secondary school foundation in chemistry by electing a basic two-semester introductory course of a general nature or they may elect semester courses designed for non-majors. All courses in chemistry satisfy the divisional distribution requirement.

STUDY ABROAD

Students who wish to complete a chemistry major (or chemistry requirements for pre-medical study) as well as to study abroad during their junior year are encouraged to begin taking chemistry in their first semester at Williams, and should consult with members of the department as early as possible.

FAQ

Students MUST contact departments/programs BEFORE assuming study away credit will be granted toward the major or concentration.

Can your department or program typically pre-approve courses for major/concentration credit?

Yes, in some cases, if appropriate course information is available in advance (e.g. syllabi and/or course descriptions), though students should be sure to contact the department. We can give provisional approval in some cases if enough detail is available, but we always ask to see the details after the course is completed before signing off on the major credit.

What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?

Course title and description, complete syllabus, including readings/assignments, and complete description of laboratory program. The biggest question is whether or not there is a lab component of the course and whether it is sufficient to fulfill the equivalent lab experience of Williams courses.

Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?

No official restrictions, but we advise our students to take the majority of their chemistry courses at Williams.

Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?

Yes. We have several special requirements. Only one non-lab class can be used toward the upper-level major requirements. This is usually the restriction that causes difficulty with study abroad—where appropriate lab courses may not be available. One of the lab courses must also meet our departmental "quantitative requirement." In principle, this could be met by a course taken abroad, but we would likely be more conservative in authorizing this equivalency.

Are there specific major requirements that cannot be fulfilled while on study away?

No. In principle, all major requirements could be filled abroad, but laboratory programs abroad are not always sufficiently rigorous to meet our standards. We look for at least 40 hours of wet-lab time for the lab component. Importantly, this cannot be work in a professor's research lab, but must be "exercises" giving our students practice with standard techniques and methods of analysis.

Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)

Yes. The lab requirements that I've mentioned above are the main complicating factors. Also our first two years of ("introductory") chemistry courses are taught in an unconventional way. If a student had not yet completed all four of those courses before studying abroad, they would need to be aware of special timing that might complicate things. For our first two years of instruction, we teach one semester of introductory chemistry followed by two semesters of organic chemistry, and top things off with a final semester of a course that is somewhat specific to Williams. There are ways to take "equivalent" courses elsewhere, but we would need to work very closely with the student to ensure that all of the pieces fit together appropriately.

Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn't:

None to date, but there may have been times when the lab component of a course was not sufficient and we were only able to assign major credit for a non-lab course instead of a course-with-a-lab.

CHEM 113 (F) Chemistry and Crime: From Sherlock Holmes to Modern Forensic Science

In this course, designed for students who do not plan to major in the natural sciences, we use a case-oriented approach to explore selected topics of forensic science. These include: (1) the scientific and technological foundation for the examination of physical, chemical, and biological items of evidence, and (2) the scope of expert qualifications and testimony, the legal status of scientific techniques, and the admissibility of the results in evidence. The analysis of trace evidence, including glass, soil, gunpowder residues and bullet fragments, and inorganic and heavy metal poisons are discussed through an understanding of the basic concepts of chemistry and analytical chemistry. Forensic toxicology and pharmacology are applied to the analysis of alcohol, poisons, and drugs based upon the principles of organic chemistry and biochemistry. The characterization of blood and other body fluids necessitate an understanding of serology and molecular genetics. The cases which stimulate the exploration of these areas include: the John and Robert Kennedy assassinations, the Jeffrey MacDonald case (*Fatal Vision*), the Wayne Williams case, the deaths of celebrities Marilyn Monroe, John Belushi, and Janis Joplin, the authenticity of the Shroud of Turin, the Casey Anthony case, the Tylenol poisonings, and the identity of Anastasia. Interactive demonstration sessions provide an appreciation of scientific experimentation in general and the work of a crime lab in particular. It includes an analysis of evidence and provides an opportunity to learn forensic techniques such as chromatography (for ink, drug, and fire accelerant analysis), spectroscopy (for alcohol and drug analysis), and electrophoresis (for DNA fingerprinting).

Class Format: three times per week

Requirements/Evaluation: problem sets and/or quizzes, hour tests, a final exam, and papers

Prerequisites: none; designed for the non-science major who does not intend to pursue a career in the natural sciences; not open to students who have taken CHEM 151, 153, 155, 156/251, or 256

Enrollment Limit: 30

Enrollment Preferences: seniors and juniors

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3)

Not offered current academic year

CHEM 114 (S) The Science Behind Materials: Shaping the Past and Future of Society (QFR)

We are surrounded by materials. They have fulfilled human needs since ancient times. From Phoenician glass to flexible OLED displays, materials have impacted society and changed the way humans lead their lives. What makes materials the way they are? Why are some brittle while others are ductile? How can we design materials with specific properties that will solve tomorrow's problems? To answer these questions, we have to think about materials at the atomic scale, looking at how their smallest building blocks organize into specific structures. In this course, we will explore the relationships between structure, processing, and properties for a range of materials including metals, ceramics, polymers, and composites. We will talk about some of the cutting-edge research that materials scientists are working on today, concluding with an outlook to potential applications of emerging technologies.

Requirements/Evaluation: Weekly quizzes and problem sets, two exams, and oral presentations.

Prerequisites: not appropriate for CHEM, BIOL, PHYS majors, or for those who have taken CHEM 151, 153, or 155

Enrollment Limit: 20

Enrollment Preferences: juniors and seniors; not appropriate for CHEM, BIOL, PHYS majors, or for those who have taken CHEM 151, 153, or 155

Expected Class Size: 20

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Spring 2022

LEC Section: 01 MR 1:10 pm - 2:25 pm Amnon G Ortoll-Bloch

CHEM 115 (F) AIDS: The Disease and Search for a Cure

Since the discovery of the human immunodeficiency virus (HIV-1) in 1983, modern techniques of molecular biology have revealed much about its structure and life cycle. The intensity of the scientific investigation directed at HIV-1 is unprecedented in history. We now know more about this virus than any other known pathogen. However, the early optimism concerning the prospects for an effective AIDS vaccine has now waned and HIV strains that are resistant to drug therapies are common. We are now three decades into the AIDS pandemic and the World Health Organization estimates that there are more than 34 million HIV-infected persons worldwide. After an introduction to chemical structure, we examine the molecular biology of the HIV virus, the molecular targets of anti-HIV drugs, and the prospects for a cure. We look at how HIV-1 interacts with the human immune system and discuss prospects for developing an effective HIV vaccine.

Class Format: three hours per week

Requirements/Evaluation: problem sets, a midterm, quizzes, a final exam, and a presentation/discussion

Prerequisites: none; designed for the non-science major who does not intend to pursue a career in the natural sciences

Enrollment Limit: 45

Expected Class Size: 45

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3)

Attributes: PHLH Biomedical Determinants of Health

Not offered current academic year

CHEM 117 (S) Roses are Red, Violets are Blue: The Origins, Perception, and Impact of Color (QFR)

Have you ever been tickled pink? Felt blue? Seen red?, Been green with envy? The course will consider color, starting with the physical and chemical origins of color (the electromagnetic spectrum, the absorption and emission of electromagnetic radiation, refraction, diffraction, incandescence, fluorescence, phosphorescence, iridescence). We will develop an understanding of chemical bonding and how that influences color. We will cover how we measure and describe color from a scientific perspective as well as how we can generate materials and devices with different color properties (liquid crystal displays, light emitting diodes for instance). From there we will discuss pigments used in works of art and textiles over time, the characteristics that make certain pigments suitable for particular applications. If we have time, we will touch on the historical and cultural impacts and meanings of different pigments and hues, the biological perception of color, and some color theory.

Class Format: There may be some brief laboratory exercises, we won't use the scheduled lab blocks every week, but we will use some.

Requirements/Evaluation: exams, problem sets, quizzes, a paper, brief laboratory exercises, and a final exam

Prerequisites: non-science students; students who have taken any introductory chemistry or physics courses are ineligible

Enrollment Limit: 12

Enrollment Preferences: first-years and sophomores

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course will require students to become comfortable with some quantitative descriptions of light and its interaction with matter.

Not offered current academic year

CHEM 151 (F) Introductory Chemistry (QFR)

This course provides an introduction to chemistry for those students with little or no high school chemistry. Students will be introduced to concepts fundamental to studying matter at the molecular level. Principal topics include introductions to the nature of atoms and molecules, stoichiometry, solubility rules and equilibria, gas laws, chemical equilibrium, acid-base reactions, periodic relationships, chemical bonding, molecular structure, intermolecular forces, oxidation-reduction reactions, and related applications. Laboratory work comprises a system of qualitative analysis and quantitative techniques. The course provides preparation for further study of organic chemistry, biochemistry, physical and inorganic chemistry and is intended for students who are anticipating professional study in chemistry, in related sciences, or in one of the health professions, as well as for those students who are interested in exploring the fundamental ideas of chemistry as part of their general education. This course may be taken pass/fail; however, students who are considering graduate study in science or in the health professions should elect to take this course for a grade.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: electronic and written weekly problem set assignments, laboratory work and analysis, quizzes, two tests, and a final exam

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to speak with a faculty member during First Days.

Enrollment Limit: 16/lab

Enrollment Preferences: first-year students; students who have studied chemistry for one or more years are directed to CHEM 153 or 155

Expected Class Size: 32

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 151 may be taken concurrently with MATH 102--see under Mathematics; CHEM 151 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2021

LEC Section: 01 MWF 8:30 am - 9:45 am Sarah L. Goh

LAB Section: 02 M 1:00 pm - 5:00 pm Sarah L. Goh

LAB Section: 03 T 1:00 pm - 5:00 pm Laura R. Strauch

LAB Section: 04 W 1:00 pm - 5:00 pm Laura R. Strauch

CHEM 153 (F) Concepts of Chemistry (QFR)

This course broadens and deepens the foundation in chemistry of students who have had typically one year of chemistry at the high school level. Most students begin study of chemistry at Williams with this course. Familiarity with stoichiometry, basic concepts of equilibria, and the model of an atom is expected. Principal topics for this course include kinetic theory of gases, modern atomic theory, molecular structure and bonding, states of matter, chemical equilibrium (acid-base and solubility), and an introduction to atomic and molecular spectroscopies. Laboratory periods will largely focus on experiment design, data analysis, literature, scientific writing, ethics, and other skills critical to students' development as scientists. There may also be the opportunity for some hands-on laboratory experience for students who are on-campus. The course is of interest to students who anticipate professional study in chemistry, related sciences, or one of the health professions, as well as to those who want to explore the fundamentals of chemistry as part of their general education. This course may be taken pass/fail; however, students who are considering graduate study in science or in the health professions should elect to take this course for a grade.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quantitative weekly problem set assignments, laboratory work and reports, hour tests, and a final exam

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to speak with a faculty member during First Days.

Enrollment Limit: 35/lecture

Enrollment Preferences: incoming first year students also must speak with a faculty member during First Days

Expected Class Size: 70

Grading: yes pass/fail option, no fifth course option

Unit Notes: CHEM 153 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2021

LEC Section: 01 MWF 9:00 am - 9:50 am Lee Y. Park

LEC Section: 02 MWF 11:00 am - 11:50 am Lee Y. Park

LAB Section: 03 M 1:00 pm - 5:00 pm Lee Y. Park

LAB Section: 04 T 1:00 pm - 5:00 pm Jennifer K. Rosenthal

LAB Section: 05 W 1:00 pm - 5:00 pm Jennifer K. Rosenthal

LAB Section: 06 R 1:00 pm - 5:00 pm Laura R. Strauch

LAB Section: 07 T 8:00 am - 12:00 pm Laura R. Strauch

CHEM 155 (F) Principles of Modern Chemistry (QFR)

This course is designed for students with a strong preparation in chemistry (including laboratory experience) in secondary school, such as provided by an Advanced Placement chemistry course (or equivalent) with a corresponding AP Chemistry Exam score of 5 (or a 6 or 7 on the IB Exam, or equivalent). Topics include chemical thermodynamics, kinetics, structure and bonding, coordination chemistry, electrochemistry and spectroscopy and their application to fields such as materials science, catalysis, environmental, biological, and medicinal chemistry. Laboratory periods will focus on hands-on skills, data representation and analysis, scientific writing, exploration of the scientific literature, and other skills critical to students' development as scientists. This course is designed for students who are anticipating further study in chemistry, related sciences, or one of the health professions, as well as for students who want to explore the fundamental ideas of chemistry as part of their general education.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: frequent short assignments in preparation for class, quantitative weekly problem sets, laboratory work and reports, an hour test, and a final exam

Prerequisites: Students are required to take the online Chemistry Placement Survey prior to registering for the course (chemistry.williams.edu/placement); incoming first-year students are required to speak with a faculty member during First Days.

Enrollment Limit: 16/lab

Enrollment Preferences: first year students and sophomores; incoming first year students also must meet with a faculty member during First Days

Expected Class Size: 32

Grading: no pass/fail option, no fifth course option

Unit Notes: CHEM 155 or its equivalent is a prerequisite to CHEM 156; one of CHEM 151 or 153 or 155 required for the BIMO concentration

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem sets in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Fall 2021

LEC Section: 01 MWF 8:00 am - 8:50 am Christopher Goh

LAB Section: 02 W 1:00 pm - 5:00 pm Christopher Goh

LAB Section: 03 R 1:00 pm - 5:00 pm Christopher Goh

CHEM 156 (S) Organic Chemistry: Introductory Level (QFR)

This course provides the necessary background in organic chemistry for students who are planning advanced study or a career in chemistry, the biological sciences, or the health professions. It initiates the systematic study of the common classes of organic compounds with emphasis on theories of structure and reactivity. The fundamentals of molecular modeling as applied to organic molecules are presented. Specific topics include basic organic structure and bonding, isomerism, stereochemistry, molecular energetics, the theory and interpretation of infrared and nuclear magnetic spectroscopy, substitution, elimination and addition reactions. The coordinated laboratory work includes purification and separation techniques, structure-reactivity studies, organic synthesis, IR and NMR spectroscopy, and the identification of unknown compounds.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quantitative problem solving, laboratory performance, three midterm exams, and a final exam

Prerequisites: CHEM 151 or 153 or 155 or placement exam or permission of instructor

Enrollment Limit: 40/lecture

Enrollment Preferences: Seniors, juniors, sophomores, first-year students

Expected Class Size: 100

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular and substantial problem solving in which quantitative/formal reasoning skills are practiced and evaluated.

Attributes: BIMO Required Courses

Spring 2022

LEC Section: 01 MWF 8:00 am - 8:50 am Kerry-Ann Green

LEC Section: 02 MWF 9:00 am - 9:50 am Ben W. Thuronyi

LAB Section: 03   M 1:00 pm - 5:00 pm

LAB Section: 04   T 1:00 pm - 5:00 pm

LAB Section: 05   W 1:00 pm - 5:00 pm

LAB Section: 06   R 1:00 pm - 5:00 pm

LAB Section: 07   M 1:00 pm - 5:00 pm

LAB Section: 08   T 1:00 pm - 5:00 pm

LAB Section: 09   W 1:00 pm - 5:00 pm

LAB Section: 10   R 1:00 pm - 5:00 pm

CHEM 251 (F) Organic Chemistry: Intermediate Level

This course is a continuation of Chemistry 156 and it concludes the systematic study of the common classes of organic compounds with emphasis on theories of structure and reactivity. Specific topics include radical chemistry, an introduction to mass spectrometry and ultraviolet spectroscopy, the theory and chemical reactivity of conjugated and aromatic systems, the concepts of kinetic and thermodynamic control, an extensive treatment of the chemistry of the carbonyl group, alcohols, ethers, polyfunctional compounds, the concept of selectivity, the fundamentals of organic synthesis, an introduction to carbohydrates, carboxylic acids and derivatives, acyl substitution reactions, amines, and an introduction to amino acids, peptides, and proteins. The coordinated laboratory work includes application of the techniques learned in the introductory level laboratory, along with new functional group analyses, to the separation and identification of several unknown samples. Skills in analyzing NMR, IR, and MS data are practiced and further refined.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: midterm exams, problem sets, laboratory performance, including written lab reports, and a final exam

Prerequisites: CHEM 156 or permission of instructor

Enrollment Limit: 45/lecture

Enrollment Preferences: seniors, juniors, then sophomores

Expected Class Size: 100

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Required Courses

Fall 2021

LEC Section: 01   MWF 8:00 am - 8:50 am   Thomas E. Smith

LEC Section: 02   MWF 10:00 am - 10:50 am   Amanda K. Turek

LAB Section: 03   M 1:00 pm - 5:00 pm   Amanda K. Turek

LAB Section: 04   T 1:00 pm - 5:00 pm   Jenna L. MacIntire

LAB Section: 05   W 1:00 pm - 5:00 pm   Thomas E. Smith

LAB Section: 06   R 1:00 pm - 5:00 pm   Jennifer K. Rosenthal

LAB Section: 07   M 1:00 pm - 5:00 pm   Jennifer K. Rosenthal

LAB Section: 08   W 1:00 pm - 5:00 pm   Jenna L. MacIntire

CHEM 255 (F) Organic Chemistry: Intermediate Level--Special Laboratory Section

This course is a continuation of CHEM 156 and contains the same material as CHEM 251 except for the laboratory program described below: The aim of this advanced laboratory section is to enrich and enhance the laboratory experiences of motivated students of recognized ability by providing a laboratory program that more closely resembles the unpredictable nature and immediacy of true chemical research. Students synthesize, isolate, and characterize (using a range of modern physical and spectroscopic techniques) a family of unknown materials in a series of experiments constituting an integrated, semester-long investigation. A flexible format is employed in which the students are responsible for helping to plan the course of their laboratory work based upon discussions with the instructor about the previous week's experimental results. Students are drawn from CHEM 156 with placement based upon student selection and nomination by the CHEM 156 instructor. Participants attend their regular CHEM 251 lecture but attend the special laboratory section instead of a CHEM 251 laboratory section.

Class Format: lecture, three hours per week and laboratory, four hours per week; weekly one-hour discussion

Requirements/Evaluation: the requirements for the CHEM 251 lecture and performance in this special laboratory section including written laboratory reports and participation in discussions

Prerequisites: permission of instructor

Enrollment Limit: 12

Enrollment Preferences: sophomores

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Unit Notes: course was developed under a grant from the Ford Foundation

Distributions: (D3)

Not offered current academic year

CHEM 256 (S) Advanced Chemical Concepts

This course treats an array of topics in modern chemistry, emphasizing broad concepts that connect and weave through the various subdisciplines of the field--biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. It provides the necessary background in chemical science for students who are planning advanced study or a career in chemistry, biological science, geoscience, environmental science, or a health profession. Topics include coordination complexes, thermodynamics, electrochemistry, and kinetics. Students must select a laboratory section, either a standard or an intensive section. The standard laboratory sections will give students hands-on experience involving synthesis, characterization, and reactivity studies of coordination and organic complexes; spectroscopic analyses; thermodynamics; electrochemistry; and kinetics. Students will hone their skills in the presentation of results through written reports and worksheets. The aim of the intensive laboratory section (lab section 07) is to provide a program that more closely resembles the unpredictable nature of authentic chemical research. This format will require students to think flexibly and independently, and be willing to take responsibility for determining the path of their laboratory work over the course of the semester. This section will require a weekly discussion period in addition to the laboratory session. The timing of the discussion period will be determined once students have been selected. This section will emphasize collaborative work, experimental design, data analysis and the communication and presentation of results. Enrollment will be limited to students with a strong interest in developing their chemistry laboratory skills. Interested students should consult with the course instructor for more information.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: homework assignments, laboratory work, quizzes, midterm exam, and a final exam

Prerequisites: CHEM 251/255, or permission of instructor

Enrollment Limit: 30/lecture

Enrollment Preferences: seniors, juniors, then sophomores

Expected Class Size: 60

Grading: no pass/fail option, yes fifth course option

Unit Notes: for the BIMO concentration, CHEM 256 not required if CHEM 155 was taken

Distributions: (D3)

Attributes: BIMO Required Courses

Spring 2022

LEC Section: 01 MWF 8:00 am - 8:50 am Lee Y. Park

LEC Section: 02 MWF 10:00 am - 10:50 am Lee Y. Park

LAB Section: 03 M 1:00 pm - 5:00 pm

LAB Section: 04 T 1:00 pm - 5:00 pm

LAB Section: 05 W 1:00 pm - 5:00 pm

LAB Section: 06 R 1:00 pm - 5:00 pm

LAB Section: 07 Cancelled

CHEM 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: MATH 319 CHEM 319 BIOL 319 PHYS 319 CSCI 319

Secondary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: two afternoons of lab, with one hour of lecture, per week. In most weeks, we will meet one day for lecture discussions.

Requirements/Evaluation: lab participation, several short homework assignments, one lab report, a programming project, and a grant proposal

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

MATH 319 (D3) CHEM 319 (D3) BIOL 319 (D3) PHYS 319 (D3) CSCI 319 (D3)

Quantative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Attributes: BIGP Courses BIMO Interdepartmental Electives

Not offered current academic year

CHEM 321 (F) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quizzes, two midterm exams, a final exam, problem sets and performance in the laboratories including lab reports

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Limit: 16/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 48

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2021

LEC Section: 01 MWF 10:00 am - 10:50 am Ben W. Thuronyi

LAB Section: 02 M 1:00 pm - 5:00 pm Ben W. Thuronyi

LAB Section: 03 T 1:00 pm - 5:00 pm Ben W. Thuronyi

LAB Section: 04 R 1:00 pm - 5:00 pm Jenna L. MacIntire

CHEM 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: BIOL 322 BIMO 322 CHEM 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions that are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: Lecture three hours per week and laboratory two hours per week.

Requirements/Evaluation: several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of data

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit: 60

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 60

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) BIMO 322 (D3) CHEM 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2022

LEC Section: 01 TR 9:55 am - 11:10 am Cynthia K. Holland

LAB Section: 02 T 1:00 pm - 4:00 pm Janis E. Bravo

LAB Section: 03 W 1:00 pm - 4:00 pm Janis E. Bravo

LAB Section: 04 R 1:00 pm - 4:00 pm Janis E. Bravo

CHEM 324 (S) Enzyme Kinetics and Reaction Mechanisms

Enzymes are complex biological molecules capable of catalyzing chemical reactions with very high efficiency, stereo-selectivity and specificity. The study of enzymatically-catalyzed reactions gives insight into the study of organic reaction mechanisms in general, and into the topic of catalysis especially. This course explores the methods and frameworks for determining enzymatic reaction mechanisms. These methods are based on a firm foundation of organic reaction mechanisms and chemical kinetics. We will investigate the major types of biochemical reactions, focusing on their catalytic mechanisms and how those mechanisms can be elucidated. We will lay the foundation for this mechanistic consideration with discussion of transition state theory, structure-reactivity relationships, steady state and pre-steady kinetics, use of isotopes, genetic modification, and other tools for probing enzymatic reactions. We will also examine the catalytic roles of a variety of vitamins and cofactors.

Class Format: three hours per week

Requirements/Evaluation: problem sets, quizzes, a midterm exam, a paper, and a final exam

Prerequisites: CHEM/BIOL/BIMO 321 or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: Chemistry majors or BIMO concentrators

Expected Class Size: 10

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Spring 2022

LEC Section: 01 TR 8:30 am - 9:45 am Amy Gehring

CHEM 326 (S) Chemical and Synthetic Biology

This course surveys the rapidly evolving, interdisciplinary and interconnected fields of chemical and synthetic biology. Chemical biology uses precise molecular-level manipulations to influence living systems from the bottom up, often by introducing components that are foreign to nature. Synthetic biology takes advantage of existing molecular technology and adopts an engineering mindset to reprogram life. Students will achieve literacy through immersion in chemical and synthetic biology. We will prioritize broad exposure to these fields, their vocabulary, culture, practices and ideas, through extensive engagement with the primary literature that expert practitioners use to teach themselves. The instructor will guide, facilitate, and give feedback, but de-emphasize direct instruction. Students take on the agency and responsibility for assimilating meaning from the material and working together effectively to advance everyone's understanding. This model prioritizes skills important for autonomous and collaborative work in real-world scientific and professional fields. Topics we will cover include synthetic genomes, metabolic engineering, chemical synthesis and manipulation of biomacromolecules, directed evolution, and reworking of the central dogma.

Class Format: lecture, three hours per week

Requirements/Evaluation: Course work includes consistent and intensive engagement with primary literature, weekly short presentations, informal writing assignments, response papers/problem sets, and an independent research project with presentation and writing components. The workload is designed to be distributed evenly throughout the semester. There are no exams.

Prerequisites: CHEM/BIOL/BIMO 321

Enrollment Limit: 20

Enrollment Preferences: senior and junior Chemistry and Biology majors with a demonstrated interest in chemical or synthetic biology

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Not offered current academic year

CHEM 335 (F) Inorganic/Organometallic Chemistry

This course covers fundamental aspects of the chemistry of main group elements and transition metals, and highlights how these properties are key to understanding the roles of these elements in a range of applications, from the catalysis of synthetic organic transformations, the functions of enzymatic processes, the production of commodity chemicals such as plastics, to the actions of metal-based drugs such as cis-platin. The course introduces concepts of symmetry and group theory, and their systematic application to the study of the structure, bonding, and spectroscopy of inorganic and coordination compounds. The course also covers the kinetics and mechanism of selected inorganic and organometallic reactions. Class discussions will involve exploration of the primary literature and review articles around recent developments and applications in inorganic chemistry.

Class Format: lecture, three hours per week and laboratory, four hours per week

Requirements/Evaluation: problem sets, two exams, presentations, and group-based literature reviews

Prerequisites: CHEM 155 or 256 and 251/255

Enrollment Limit: 10/lab

Enrollment Preferences: senior and junior chemistry majors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Fall 2021

LEC Section: 01 TR 8:30 am - 9:45 am Kerry-Ann Green

LAB Section: 02 Cancelled

LAB Section: 03 W 1:00 pm - 5:00 pm Kerry-Ann Green

CHEM 336 (F) Materials Chemistry

Materials have defined much of what is possible in our daily lives. Materials scientists are at the center of imagining and delivering progress, as they improve existing materials and develop new ones to meet today's needs. Materials science focuses on the relationships between the structure, processing, properties, and performance of materials. In this course, we will explore how the properties and potential applications of a solid are related to its atomic and molecular structure, as well as to its organization on larger length scales than are traditionally considered in chemistry. We will cover a variety of different types of materials including metals, ceramics, polymers, and composites. We will examine some of the latest developments in materials science, including new strategies for the synthesis of materials on different length scales, as well as a variety of potential applications of emerging technologies.

Class Format: three hours per week

Requirements/Evaluation: problem sets, reviews of research articles, two exams, and oral presentations

Prerequisites: CHEM 155 or 256 and 251/255

Enrollment Limit: 20

Enrollment Preferences: Chemistry majors

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Attributes: MTSC Courses

Fall 2021

LEC Section: 01 TR 9:55 am - 11:10 am Amnon G Ortoll-Bloch

CHEM 338 (S) Bioinorganic Chemistry: Metals in Living Systems

Bioinorganic chemistry is an interdisciplinary field that examines the role of metals in living systems. Metals are key components of a wide range of processes, including oxygen transport and activation, catalytic reactions such as photosynthesis and nitrogen-fixation, and electron-transfer processes. Metals furthermore perform regulatory roles and stabilize the structures of proteins. In medical applications, they are central to many diagnostic and therapeutic tools, and some metals are highly toxic. The course begins with a review and survey of the principles of coordination chemistry: topics such as structure and bonding, spectroscopic methods, electrochemistry, kinetics and reaction mechanisms. Building on this fundamental understanding of the nature of metals, we will explore the current literature in fields of interest in small groups, presenting our findings to the class periodically.

Class Format: The course will begin with a series of lectures on principles of coordination chemistry, followed by tutorial meetings to discuss journal articles and book materials.

Requirements/Evaluation: Evaluation based on problem sets, two exams, class engagement, a class presentation, and a final project.

Prerequisites: CHEM 155 or CHEM 256 and 251/255

Enrollment Limit: 10

Enrollment Preferences: Chemistry majors and BIMO concentrators

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Not offered current academic year

CHEM 341 (S) Toxicology and Cancer

Cross-listings: ENVI 341 CHEM 341

Primary Cross-listing

What is a poison and what makes it poisonous? Paracelcus commented in 1537: "What is not a poison? All things are poisons (and nothing is without poison). The dose alone keeps a thing from being a poison." Is the picture really this bleak; is modern technology-based society truly swimming in a sea of toxic materials? How are the nature and severity of toxicity established, measured and expressed? Do all toxic materials exert their effect in the same manner, or can materials be poisonous in a variety of different ways? Are the safety levels set by regulatory agencies low enough for a range of common toxic materials, such as mercury, lead, and certain pesticides? How are poisons metabolized and how do they lead to the development of cancer? What is cancer and what does it take to cause it? What biochemical defense mechanisms exist to counteract the effects of poisons?

This course attempts to answer these questions by surveying the fundamentals of modern chemical toxicology and the induction and progression of cancer. Topics will range from description and quantitation of the toxic response, including risk assessment, to the basic mechanisms underlying toxicity, mutagenesis, carcinogenesis, and DNA repair.

Class Format: three times per week

Requirements/Evaluation: two hour tests, a class presentation and paper, participation in discussion sessions, a self-exploration of the current toxicological literature, and a final exam

Prerequisites: CHEM 156; may be taken concurrently with CHEM 251/255; a basic understanding of organic chemistry

Enrollment Limit: 30

Expected Class Size: 24

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 341 (D3) CHEM 341 (D3)

Attributes: BIMO Interdepartmental Electives ENVI Natural World Electives PHLH Biomedical Determinants of Health

Not offered current academic year

CHEM 342 (S) Synthetic Organic Chemistry

The origins of organic chemistry are to be found in the chemistry of living things and the emphasis of this course is on the chemistry of naturally-occurring compounds. This course presents the logic and practice of chemical total synthesis while stressing the structures, properties and preparations of terpenes, polyketides and alkaloids. Modern synthetic reactions are surveyed with an emphasis on the stereochemical and mechanistic themes that underlie them. To meet the requirements for the semester's final project, each student chooses an article from the recent synthetic literature and then analyzes the logic and strategy involved in the published work in a final paper. A summary of this paper is also presented to the class in a short seminar. There will be no laboratory component in 2022. Instead, one of the three class meetings each week will focus on discussion and presentation of reactions, mechanisms, and syntheses from the chemical literature.

Class Format: lecture, three hours per week and conference, 1.5 hours per week

Requirements/Evaluation: problem sets, midterm exams, class participation, class presentations, and a final project

Prerequisites: CHEM 256 or permission of instructor

Enrollment Limit: 16

Enrollment Preferences: Chemistry majors, seniors and juniors

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Spring 2022

LEC Section: 01 MWF 8:30 am - 9:45 am Thomas E. Smith

CHEM 344 (S) Physical Organic Chemistry

The structure of a molecule is inherently linked to its reactivity, and these correlations form the basis for understanding organic reaction mechanisms. This course advances the understanding from previous organic courses through a detailed examination of the concepts that underlie these structure/reactivity relationships, including molecular strain and stability, acid/base chemistry, steric and electronic effects, and aromaticity. These concepts will also be explored in the context of specific classes of reaction mechanisms. Classical and modern experimental and theoretical tools used to elucidate reaction mechanisms will also be presented, including reaction kinetics, isotope effects, and linear free energy relationships. By studying the primary literature, we will see how these experiments have been applied to the elucidation of reaction mechanism, while also learning to design a set of experiments for study of mechanisms of contemporary interest.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: problem sets, exams, laboratory reports, presentations, and class participation

Prerequisites: CHEM 155 or CHEM 256 and 251/255

Enrollment Limit: 7/lab

Enrollment Preferences: Chemistry majors: seniors, juniors, sophomores

Expected Class Size: 14

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Spring 2022

LEC Section: 01 MWF 12:00 pm - 12:50 pm Amanda K. Turek

LAB Section: 02 W 1:30 pm - 5:00 pm Amanda K. Turek

LAB Section: 03 R 1:30 pm - 5:00 pm Amanda K. Turek

CHEM 348 (F) Polymer Chemistry

From synthetic to natural macromolecules, we encounter polymers everywhere and everyday. This course explores the multitude of synthetic techniques available and discusses how structure defines function. Topics include condensation and chain (anionic, cationic, radical) polymerizations, dendrimers, controlling molecular weight, ring opening, and biopolymer syntheses. Fundamentals of composition and physical properties of polymers, and methods of characterization are also covered.

Class Format: lecture three hours per week and laboratory four hours per week

Requirements/Evaluation: weekly literature discussions, two exams, and a final project

Prerequisites: CHEM 251/255

Enrollment Limit: 12

Enrollment Preferences: Chemistry majors

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives MTSC Courses

Not offered current academic year

CHEM 361 (F) Quantum Chemistry and Chemical Dynamics

This course provides an introduction to quantum mechanics which serves as the basis for understanding atomic and molecular structure as well as spectroscopic methods. This leads to a discussion of chemical kinetics and molecular reaction dynamics in the gas phase and in solution.Computational chemistry methods are used to illustrate chemical concepts, to interpret experimental data, and to extend hypotheses. Applications of these principles are chosen from contemporary research fields, including polymer chemistry, photochemistry, atmospheric chemistry, and solid and liquid state chemistry. Quantitative laboratory experiments and consultation with the scientific literature provide the background necessary for carrying out an independent theoretical or experimental project.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: class participation, problem sets, exams, laboratory work, and an independent project

Prerequisites: CHEM 155 or 256

Enrollment Limit: 8/lab

Enrollment Preferences: seniors, then juniors

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2021

LEC Section: 01 MWF 11:00 am - 11:50 am John W. Thoman

LAB Section: 02 M 1:00 pm - 5:00 pm John W. Thoman

LAB Section: 03 W 1:00 pm - 5:00 pm John W. Thoman

CHEM 364 (S) Instrumental Methods of Analysis

Cross-listings: ENVI 364 CHEM 364

Primary Cross-listing

Instrumental methods of analysis provide scientists with different lenses to observe and elucidate fundamental chemical phenomena and to measure parameters and properties at the atomic, molecular, and bulk scales. This course introduces a framework for learning about a variety of instrumental techniques that typically include chromatography, mass spectrometry, thermal methods, atomic and molecular absorption and emission spectroscopy, X-ray diffraction, and optical and electron microscopies. Students complete two 5-6 week long laboratory projects and gain hands-on experience and project planning skills to study molecules and materials of interest. This practical experience is complemented by lectures that cover the theory and broader applications of these techniques. Students also explore the primary literature and highlight recent advances in instrumental methods that address today's analytical questions. The skills learned are useful in a wide variety of scientific areas and will prepare you well for research endeavors.

Class Format: lecture, two times per week and laboratory, four hours per week; periodic small group meetings to plan laboratory research projects

Requirements/Evaluation: Weekly data analysis and project planning assignments for laboratory and analysis of readings for class, problem sets, two project reports and presentations, one oral presentation of an application of instrumental methods, a final independent literature project and presentation; demonstrated progress in research skills, and project engagement.

Prerequisites: CHEM 155 or 256 and 251/255; may be taken concurrently with CHEM 256 with permission of instructor

Enrollment Limit: 8/lab

Enrollment Preferences: Chemistry and Environmental Studies majors

Expected Class Size: 16

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 364 (D3) CHEM 364 (D3)

Attributes: BIMO Interdepartmental Electives ENVI Natural World Electives EVST Methods Courses MTSC Courses

Spring 2022

LEC Section: 01 TR 9:55 am - 11:10 am Christopher Goh

LAB Section: 02 M 1:00 pm - 5:00 pm Christopher Goh

LAB Section: 03 T 1:00 pm - 5:00 pm Christopher Goh

CHEM 366 (S) Thermodynamics and Statistical Mechanics

The thermodynamic laws provide us with our most powerful and general scientific principles for predicting the direction of spontaneous change in physical, chemical, and biological systems. This course develops the concepts of energy, entropy, free energy, temperature, heat, work, and chemical potential within the framework of classical and statistical thermodynamics. The principles developed are applied to a variety of problems: chemical reactions, phase changes, energy technology, industrial processes, and environmental science. Laboratory experiments provide quantitative and practical demonstrations of the theory of real and ideal systems studied in class.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: class participation, oral presentations, problem sets, laboratory work, and an independent project

Prerequisites: CHEM 155 or 256, and basic knowledge of applied integral and differential calculus

Enrollment Limit: 16/lab

Enrollment Preferences: Chemistry majors: seniors, juniors, then sophomores

Expected Class Size: 16

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Spring 2022

LEC Section: 01 MWF 11:00 am - 12:15 pm Enrique Peacock-López

LAB Section: 02 M 1:00 pm - 5:00 pm Enrique Peacock-López

CHEM 367 (S) Biophysical Chemistry

This course is designed to provide a working knowledge of basic physical chemistry to students primarily interested in the biochemical, biological, or medical professions. Topics of physical chemistry are presented from the viewpoint of their application to biochemical problems. Three major areas of biophysical chemistry are discussed: 1) the conformation of biological macromolecules and the forces that stabilize them; 2) techniques for the study of biological structure and function including spectroscopic, hydrodynamic, electrophoretic, and chromatographic; 3) the behavior of biological macromolecules including ligand interaction and conformational transitions.

Class Format: lecture/discussion three hours per week and laboratory four hours per week

Requirements/Evaluation: problem sets and/or quizzes, laboratory work, and exams

Prerequisites: CHEM 155 or 256 and 251/255, and MATH 140 or equivalent

Enrollment Limit: 6/lab

Enrollment Preferences: junior and senior Chemistry majors

Expected Class Size: 18

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Attributes: BIMO Interdepartmental Electives

Not offered current academic year

CHEM 368 (S) Computational Chemistry and Molecular Spectroscopy (QFR)

This tutorial provides an introduction to the principles of computational quantum mechanics and their application to problems of chemical interest such as chemical bonding, chemical reactivity, and molecular spectroscopy. Emphasis is placed upon modern electronic structure calculations, their fundamentals, practical considerations, interpretation, and applications to current research questions. Under guidance in sessions and through independent work, students will use computational methods to explore assigned weekly research problems. The research results will be presented to and discussed with the tutorial partner at the end of each week.

Requirements/Evaluation: tutorial participation, presentations, and submitted papers

Prerequisites: CHEM 361 or equivalent background in Physics

Enrollment Limit: 10

Enrollment Preferences: Chemistry majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantative/Formal Reasoning Notes: This course fulfills the QFC requirement with problem sets for assignments in which quantitative/formal reasoning skills are practiced.

Spring 2022

TUT Section: T1 TBA Enrique Peacock-López

CHEM 373 (F) Environmental Organic Chemistry

Cross-listings: ENVI 373 CHEM 373

Primary Cross-listing

This course introduces students to the methods used to assess the risks posed by organic chemicals to human, animal, and ecosystem health. Our goal is to develop a quantitative understanding for how specific features of organic molecular structure directly dictate a given molecule's environmental fate. We will begin by using thermodynamic principles to estimate the salient physiochemical properties of molecules (e.g., vapor pressure, solubility, charging behavior, etc.) that impact the distribution, or partitioning, of organic chemicals between air, water, soils, and biota. Then, using quantitative structure activity relationships, we will predict the degradation kinetics resulting from natural nucleophilic, photochemical, and biological processes that determine chemical lifetime in the environment.

Class Format: Lecture/discussion; lecture, three hours per week and discussion, 75 minutes per week.

Requirements/Evaluation: weekly problem sets, two midterm exams, a final exam, participation in discussion, an independent research proposal

Prerequisites: CHEM 251 and either CHEM 155 or CHEM 256. ENVI 102 is strongly recommended.

Enrollment Limit: 15

Enrollment Preferences: junior and senior Chemistry and Environmental Studies majors with a demonstrated interest in environmental chemistry

Expected Class Size: 15

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 373 (D3) CHEM 373 (D3)

Attributes: ENVI Natural World Electives EVST Environmental Science

Not offered current academic year

CHEM 393 (F) Junior Research and Thesis: Chemistry

Chemistry junior research and thesis.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Fall 2021

HON Section: 01 F 1:10 pm - 2:25 pm Sarah L. Goh

CHEM 394 (S) Junior Research and Thesis: Chemistry

Chemistry junior research and thesis.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2022

HON Section: 01 F 1:10 pm - 2:25 pm Sarah L. Goh

CHEM 397 (F) Independent Study, for Juniors: Chemistry

Chemistry independent study for juniors.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Fall 2021

IND Section: 01 TBA Sarah L. Goh

CHEM 398 (S) Independent Study, for Juniors: Chemistry

Chemistry independent study for juniors.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2022

IND Section: 01 TBA Sarah L. Goh

CHEM 493 (F) Senior Research and Thesis

Individual research projects in a field of interest to the student are carried out under the direction of a faculty member and culminate in a thesis; this is part of a full-year thesis (493-494). Students in this program are strongly encouraged to keep 1:10 p.m. to 2:25 p.m. on Friday free for departmental colloquia.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2021

HON Section: 01 F 1:10 pm - 2:25 pm Sarah L. Goh

CHEM 494 (S) Senior Research and Thesis

Individual research projects in a field of interest to the student are carried out under the direction of a faculty member and culminate in a thesis; this is part of a full-year thesis (493-494). Students in this program are strongly encouraged to keep 1:10 p.m. to 2:25 p.m. on Friday free for departmental colloquia.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2022

HON Section: 01 F 1:10 pm - 2:25 pm Sarah L. Goh

CHEM 497 (F) Independent Study, for Seniors: Chemistry

Chemistry independent study for seniors. Individual research projects in a field of interest to the student are carried out under the direction of a faculty member.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3)

Fall 2021

IND Section: 01 TBA Sarah L. Goh

CHEM 498 (S) Independent Study, for Seniors: Chemistry

Chemistry independent study for seniors. Individual research projects in a field of interest to the student are carried out under the direction of a faculty member.

Requirements/Evaluation: N/A

Prerequisites: N/A

Enrollment Limit: N/A

Enrollment Preferences: N/A

Expected Class Size: N/A

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2022

IND Section: 01 TBA Sarah L. Goh

Winter Study ---

CHEM 12 (W) The Practice and Science of Pottery

This class will introduce students to exploring creative ways of working with clay and glazes, and to the science behind the processes of making pottery. This course will take place in a working Williamstown pottery studio with potter's wheels and space for hand-building and on-campus for lectures, discussions and experimental explorations of your creations. Studio time is designed to stimulate creativity and discovery, with instruction and projects tailored to each student's interests, and experiences. Students will be encouraged to consider how value and beauty can be found in that which is incomplete, impermanent, and/or imperfect. Genuineness and authenticity will be encouraged and valued. Lab-based explorations will explore the molecular processes involved in firing clay and glazing. We will discuss the properties of clay and glaze materials and how combinations of materials and high temperature processes result in mature clay bodies and glazes. We will experiment with major components in glazes and examine how these materials change during the process. Evaluation for this course includes a final project, and the critical review of the same. Assessment will take place during individual discussions with the instructors during the construction and finishing processes and in a group critique where finished work will be evaluated by all members of the class through a group discussion led by the instructors. No previous experience is necessary. The only prerequisite for this course is an honest interest in learning about the making and chemistry of pottery. Studio time is likely in the afternoons or early evenings, with an optional weekend session to accommodate schedules. Class time is about 12 hours weekly, split approximately between 6-9 hours of studio time and 3-6 h of lecture/experiment time, with some 1-2 h of additional outside-of-class assignments (readings, video viewing, writing).

Requirements/Evaluation: final project or presentation

Prerequisites: none; no pottery making experience or science background are necessary; students are encouraged to submit a brief description of their interest in participating

Enrollment Limit: 10

Enrollment Preferences: level of enthusiasm for learning the craft and science of pottery

Grading: pass/fail only

Unit Notes: Tim Duncan has been making pottery for over 30 years. He teaches in a home studio that accommodates up to 12 students, and focuses on creating lessons that stimulate creativity and discovery, while promoting the philosophies of how beauty and value can be found in that which is incomplete, impermanent, and imperfect. Tim holds a B.S. in Psychology, a clinical M.S.W., and an M.Ed. His pottery education can be traced back to the influences of Bub, Soldner, Voulkos, Pearson, and Temple.

Materials/Lab Fee: $40

Winter 2022

LEC Section: 01   MTWR 4:00 pm - 7:00 pm   Timothy Duncan, Christopher Goh

CHEM 13 (W) Ultimate Wellness: Concepts for a Happy Healthy Life

This course provides an opportunity to drastically improve your life by introducing concepts that can start making a difference in the way you feel today! We will approach nutrition, lifestyle, and happiness from a holistic perspective. Students will learn how to tune out mixed media messages and look within to find ultimate health and wellness. Topics include: Ayurveda, preventative medicine, mindfulness and meditation, healthy eating and meal planning, deconstructing cravings, sugar addiction, and finding happiness.Evaluation will be based on completion of assignments, class participation, reflective 5-page paper, creative project, and final presentation that demonstrates a level of personal growth. After signing up for this course please email Nicole at nicole@zentreewellness.com with a brief statement describing your interest in the course. In the event of over-subscription, these statements will be used in the selection process.We will meet twice a week for three-hour sessions as a group. The course will include two individual sessions--an initial health assessment plus an additional session designed to personalize the course and assist the student in applying the learned techniques. There will be several books required for this class.

Requirements/Evaluation: short paper and final project or presentation

Prerequisites: none

Enrollment Limit: 8

Enrollment Preferences: students must email a statement of interest to Nicole@zentreewellnesscom

Grading: pass/fail only

Unit Notes: Nicole Anagnos is health coach and director at Zen Tree Wellness in Williamstown. She is co-founder of the organic skin care company, Klo Organic Beauty. She also holds a master's degree in education.

Materials/Lab Fee: none

Attributes: EXPE Experiential Education Courses

Winter 2022

LEC Section: 01   TR 10:00 am - 12:50 pm   Nicole Anagnos

CHEM 16 (W) Glass and Glassblowing

Cross-listings: CHEM 16 ARTS 16

Primary Cross-listing

This course provides an introduction to both a theoretical consideration of the glassy state of matter and the practical manipulation of glass. We do flameworking with hand torches for at least 12 hours per week. While no previous experience is required, students with patience, good hand-eye coordination, and creative imagination will find the course most rewarding. The class is open to both artistically and scientifically oriented students. Note: if you are required to participate in a sustaining language program during Winter Study, this course meets at the same time.

Requirements/Evaluation: class participation, exhibition of glass projects, a 10-page paper, and a presentation to the class

Prerequisites: none

Enrollment Limit: 10

Enrollment Preferences: preference is given to juniors, sophomores, and those who express the most and earliest interest and enthusiasm by email to Professor Thoman

Grading: pass/fail only

Materials/Lab Fee: $75

This course is cross-listed and the prefixes carry the following divisional credit:

CHEM 16 ARTS 16

Attributes: EXPE Experiential Education Courses

Winter 2022

LEC Section: 01   M-F 10:00 am - 12:50 pm   John W. Thoman

CHEM 18 (W) Introduction to Research in Biochemistry

An independent experimental project in biochemistry is carried out in collaboration with a member of the Department with expertise in biochemistry. Biochemistry is a branch of chemistry that deals with the molecular details of living systems including the interaction of biologically important molecules. In the Chemistry Department, studies are underway to investigate the structure/function relationship of proteins, the interaction between proteins and RNA and DNA, the molecular basis of bacterial gene regulation, the lipid composition of model membranes, and the molecular underpinnings of viral infection.

Requirements/Evaluation: a 10-page written report is required

Prerequisites: completion of CHEM 151/3/5 and permission of the instructor and department; interested students must consult with the faculty instructor

Enrollment Limit: 4

Enrollment Preferences: expression of student interest

Grading: pass/fail only

Winter 2022

RSC Section: 01   M-F 10:00 am - 5:00 pm   Ben W. Thuronyi, Katie M. Hart

CHEM 20 (W) Introduction to Research in Inorganic Chemistry

Students in this course will carry out an independent research project in collaboration with a member of the Department with expertise in inorganic chemistry. Representative projects include the synthesis and study of polymers to encapsulate heavy metals with an eye to environmental remediation and the synthesis of coordination complexes as models of enzymes and as catalysts for the oxidation of organic compounds. The interdisciplinary nature of the project will expose students to a range of inorganic and organic synthetic protocols and analytical and spectroscopic techniques for the characterization of new materials and the monitoring of catalysis. In addition to lab work, participants will engage in an exploration of careers in chemistry and a discussion of topics of interest to chemists, such as ethics and creating a diverse workforce.

Requirements/Evaluation: a 10-page paper

Prerequisites: completion of CHEM 151/3/5 and permission of the instructor and department; interested students must consult with the faculty instructor

Enrollment Limit: 8

Enrollment Preferences: expression of student interest

Grading: pass/fail only

Materials/Lab Fee: none

Winter 2022

RSC Section: 01   M-F 10:00 am - 5:00 pm   Lee Y. Park, Christopher Goh

CHEM 23 (W) Introduction to Research in Organic Chemistry

An independent experimental project in polymer organic chemistry is carried out in collaboration with a member of the Department. Representative projects focus on controlled synthesis of block copolymers as self-assembled nanocarriers. Students involved in this work will learn techniques involved in organic synthesis, including analysis by NMR, IR, and SEC.

Requirements/Evaluation: 10-page paper

Prerequisites: completion of CHEM 151/3/5 and permission of the instructor and department; interested students must consult with the faculty instructor

Enrollment Limit: 12

Enrollment Preferences: expression of student interest

Grading: pass/fail only

Materials/Lab Fee: none

Winter 2022

RSC Section: 01 TBA Sarah L. Goh

CHEM 24 (W) Introduction to Research in Physical Chemistry

An independent experimental or theoretical project in physical chemistry is carried out in collaboration with a member of the Department with expertise in physical chemistry. Current research projects in the Department include computer modeling of non-linear, chaotic chemical and biochemical systems, atmospheric chemical dynamics, molecular modeling of water clusters, molecular dynamics simulations, and laser spectroscopy of chlorofluorocarbon substitutes.

Requirements/Evaluation: 10-page paper

Prerequisites: completion of CHEM 151/3/5 and permission of the instructor and department; interested students must consult with the faculty instructor

Enrollment Limit: 4

Enrollment Preferences: expression of student interest

Grading: pass/fail only

Materials/Lab Fee: none

Winter 2022

RSC Section: 01 W 1:00 pm - 2:50 pm Enrique Peacock-López

CHEM 31 (W) Senior Research and Thesis: Chemistry

To be taken by students registered for Chemistry 493, 494.

Class Format: independent study

Grading: pass/fail only

Winter 2022

HON Section: 01 TBA Sarah L. Goh

CHEM 41 (W) It's a Material World-What's It Made Of?-Intensive

We'll talk about how underlying atomic and molecular scale structure gives rise to physical properties that you already have an intuitive sense for: things like hardness, softness, elasticity, color, brittleness, conductivity, transparency... Once we understand how these properties arise, we can start thinking about how and why we use certain materials for particular applications and consider the historical and societal changes that result from choosing or developing new materials for those specific applications. What kinds of materials (or innovations in the skills or techniques used to produce them) have been valued over time? What has been the impact of these technological advances? From there, we can start to think about how to design new materials with new kinds of properties or combinations of properties. We'll look at old materials as well as new, and venture a bit into the modern world of materials, which involves design and characterization of meso and nanoscale structures. We'll take a little time to do some lab experiments as well, to give you a peek at some strategies used in nanofabrication, as well a chance to use some of the kinds of instrumentation used in studying nanoscale materials. Because this course is designed to count for **both** a regular full semester credit as well as a winter study credit, it will necessarily be a fairly intense experience. We're going to be moving through material pretty quickly, and it'll be hard for you to tackle the problems that you'll need to on your own at this pace in addition to doing the readings and going over class notes. So rather than structure the course to be 3 hours of uninterrupted class time/day followed by many hours of trying to do the rest of the work on your own, the course will be structured in order to provide a lot of help along the way. We'll be meeting together for more hours each day, and we'll use the extra time to do a lot of problem solving work together, as this is really the best way to work through material, as well as to do a lot of demos that will illustrate what we're talking about. There will be support available from course TAs, who will help with the problem solving during the day, as well as be available some evenings for additional help on problem sets, as well as for preparation for exams. I'm also hoping to break up the classwork a bit with some lab based activities, but that is still up in the air at this point. If we do this, there won't be any lab reports or separate homework associated with the labs that we do, though it's possible that there may be some questions on problem sets or exams associated with these parts. This course will be a non-majors level introduction to materials chemistry, with no chemistry background required.

Class Format: Lectures may be via zoom or may be via pre-recorded lectures. Problem solving will be done synchronously via zoom. We'll take breaks during the day, but you should assume that you will be expected to participate synchronously for several hours/day.

Requirements/Evaluation: a series of problem sets, two exams, and a final

Prerequisites: permission of a dean

Enrollment Limit: 12

Enrollment Preferences: students who need to make up a deficiency

Expected Class Size: NA

Grading: pass/fail only

Unit Notes: This course is designed to count for both full semester, Winter Study, and QFR credit. Once a dean approves enrollment, the Registrar's Office will register students in both CHEM 100 and CHEM 41.

Not offered current academic year

CHEM 99 (W) Independent Study: Chemistry

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study

Grading: pass/fail only

Winter 2022

IND Section: 01 TBA Sarah L. Goh