

# CHMY - Chemistry

## **CHMY 102CS Applying Chemistry to Society: 3 Credits (3 Lec)**

An introduction to contemporary chemistry in the contextual framework of current issues including the effect of human impact on the air, water, and earth. This course will examine the scientific basis for current scientific and societal issues such as depletion of the ozone layer, water pollution, acid rain, genetic engineering and nuclear fission among other issues. Topics will be addressed from a scientific viewpoint to develop knowledge and understanding of the chemical concepts that underlie these contemporary issues. The goal is to inform non-science majors of chemical and scientific issues in order to help them to become well-informed, inquiring citizens.

## **CHMY 121IN Introduction to General Chemistry: 3 Credits (2 Lec, 1 Other)**

PREREQUISITE: C- or above in M 090 or placement in a Math Level 3 via MPLEX/ACT/SAT (ACT 23 or SAT 570). Introductory general chemistry covering measurement systems, atomic structure, chemical periodicity, bonding, chemical reactions, acid-base chemistry, electrochemistry, and nuclear chemistry. Common hour exams. This is a 3 part course, you must register for CHMY 121IN lecture and recitation and CHMY 122IN which is lab

## **CHMY 122IN Introduction to General Chemistry Lab: 1 Credits (1 Lab)**

The lab to accompany CHMY 121IN. This lab is required to enroll in CHMY 121IN lecture.

## **CHMY 123 Introduction to Organic Chemistry and Biochemistry: 3 Credits (2 Lec, 1 Other)**

PREREQUISITE: CHMY 121IN and CHMY 122IN or CHMY 143 and CHMY 144. (F, Sp, Su) CO-REQUISITE: CHMY 124. An introduction into functional group organic chemistry and reactivity, and important biochemical structures, concepts, and processes. The laboratory is closely integrated with lecture coverage. This course runs concurrent with CHMY 124. Both courses are required to be taken during the same semester

## **CHMY 124 Introduction to Organic and Biochemistry Lab: 1 Credits (1 Lab)**

PREREQUISITE: CHMY 121, CHMY 122 or CHMY 143, CHMY 144 CO-REQUISITES: Runs concurrent with CHMY 123. This is the lab to accompany CHMY 123. It is required for registration in CHMY 123. This course runs concurrent with CHMY 123. Both courses are required to be taken during the same semester

## **CHMY 141 College Chemistry I: 3 Credits (3 Lec)**

PREREQUISITE: C- or above in M 121Q or placement in a Math Level 4 (ACT 25 or SAT 600). CO-REQUISITE: Runs concurrent with CHMY 142 lab The first of a two-semester course sequence about the general principles of modern chemistry with emphasis on atomic structure, chemical bonding, the periodic table, equilibria, chemical reactivity, and kinetics. It is recommended that students registering for this course have taken high school chemistry. Common Hour Exams. CHMY 142 is required to enroll in CHMY 141

## **CHMY 142 College Chemistry I Lab: 1 Credits (1 Lab)**

The lab to accompany CHMY 141. You must enroll in this class to enroll in CHMY 141.

## **CHMY 143 College Chemistry II: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 141 and CHMY 142 or CHMY 151 and CHMY 152. (F, Sp, Su) CO-REQUISITE: Runs concurrent with CHMY 144 lab The second semester of the two-semester general chemistry sequence. Topics covered during this semester include properties of solutions, chemical kinetics, aqueous equilibria, thermodynamics, and electrochemistry. Common Hour Exams. Enrollment in CHMY 144 is required to enroll in CHMY 143

## **CHMY 144 College Chemistry II Lab: 1 Credits (1 Lab)**

PREREQUISITE: CHMY 141 and CHMY 142 or CHMY 151 and CHMY 152. (F, Sp, Su) The lab to accompany CHMY 143. You must register for this course in order to register for CHMY 143

## **CHMY 151 Honors College Chemistry I: 3 Credits (3 Lec)**

PREREQUISITE: Placement in a level 5 Math. Recommended that students registering for this course either have taken calculus or are concurrently enrolled. Also recommended that students registering in this course have taken high school chemistry and/or physics, preferably AP Chemistry and/or Physics. CO-REQUISITE: Runs concurrent with CHMY 152 lab Topic coverage parallels CHMY 141, with emphasis on critical and analytical thought and with a greater reliance on math skills. Enrollment in CHMY 152 is required for registration in CHMY 151

## **CHMY 152 Honors College Chemistry I Lab: 1 Credits (1 Lab)**

The lab to accompany CHMY 151. Enrollment in CHMY 151 is required to enroll in CHMY 152.

## **CHMY 153 Honors College Chemistry II: 3 Credits (2 Lec, 1 Other)**

PREREQUISITE: A grade better than a C in CHMY 141 or CHMY 151. CO-REQUISITE: Runs concurrent with CHMY 154 lab Topic coverage parallels CHMY 143, with emphasis on critical and analytical thought and with a greater reliance on math skills. Enrollment in CHMY 154 is required to enroll in CHMY 153

## **CHMY 154 Honors College Chemistry II Lab: 1 Credits (1 Lab)**

The lab to accompany CHMY 153. You must be enrolled in CHMY 153 to register for CHMY 154.

## **CHMY 194 Seminar/Workshop: 1 Credits (1 Other)**

For the new student. Integration into the department and campus community. Scientific communication and chemical literature searching skills. Cross-listed with BCH 194.

## **CHMY 211 Elements of Organic Chemistry: 4 Credits (4 Lec)**

PREREQUISITE: C- or above in CHMY 121IN, CHMY 143, or CHMY 153. CO-REQUISITE: Concurrent enrollment in CHMY 212 A one-semester introduction to organic chemistry that covers all of the major topics of organic chemistry, but not in the same depth as the two-semester course. Topics include bonding, three-dimensional structure, nomenclature, isomers and spectroscopy (IR and NMR) as well as the reactivity of alkenes, alkynes, alkyl halides, arenes, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids and carboxylic acid derivatives. Concurrent enrollment in CHMY 212 is required. You must be enrolled in both courses in the same semester

## **CHMY 212 Elements of Organic Chemistry Lab: 1 Credits (1 Lab)**

PREREQUISITE: CHMY 144, CHMY 154, or CHMY 122. The lab to accompany CHMY 211. Concurrent enrollment in CHMY 212 is required for enrollment in CHMY 211. You must register for both courses in the same semester

## **CHMY 290R Undergraduate Research: 1-6 Credits (1-6 Other)**

Directed undergraduate research/creative activity which may culminate in a written work or other creative project. Course will address responsible conduct of research. May be repeated. Repeatable up to 99 credits.

## **CHMY 291 Special Topics: 1-4 Credits (1-4 Other)**

PREREQUISITE: None required, but some may be determined necessary by each offering department. Courses not required in any curriculum for which there is a particular one-time need, or given on a trial basis to determine acceptability and demand before requesting a regular course number Repeatable up to 12 credits.

**CHMY 292 Independent Study: 1-3 Credits (1-3 Other)**

PREREQUISITE: Consent of instructor and approval of department head. Directed research and study on an individual basis. Repeatable up to 6 credits.

**CHMY 294 Seminar/Workshop: 1 Credits (1 Other)**

PREREQUISITE: CHMY 194 or BCH 194. Introduces students to faculty research and departmental research facilities with the goal of assisting students in the process of joining a research group. Issues related to becoming engaged in research including how to keep a research notebook, lab safety, ethics, etc. are also considered. Cross-listed with BCH 294

**CHMY 311 Fundamental Analytical Chem: 4 Credits (3 Lec, 1 Lab)**

PREREQUISITE: CHMY 143 and CHMY 144 or CHMY 153 and CHMY 154

COREQUISITE: CHMY 143 and CHMY 144 or CHMY 153 and CHMY 154. Introduction to wet analytical chemistry with an emphasis on theory and applications of data statistics, the systematic treatment of equilibria, acid-base chemistry, redox equilibria, complexometric equilibria, titrations, Beer's law, and chromatography. In addition, critical quantitative lab experiments will enhance practical lab skills

**CHMY 321 Organic Chemistry I: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 143 and CHMY 144 or CHMY 153 and CHMY 154. (F, Sp) CO-REQUISITE: CHMY 322. The first of a two-semester professional sequence in organic chemistry. Topics include in-depth coverage of conformational analysis, stereochemistry, acid/base chemistry, nomenclature and reactivity of and reactions mechanism for organic compounds including radical reactions of alkanes and the reactivity of alkyl halides, alkenes and alkynes. Registration in CHMY 322 is required to enroll in CHMY 321

**CHMY 322 Organic Chemistry I Lab: 1 Credits (1 Lab)**

PREREQUISITE: CHMY 143 and CHMY 144 or CHMY 153 and CHMY 154. (F, Sp, Su) The lab to accompany CHMY 321. Concurrent enrollment in CHMY 321 is required to enroll in CHMY 322. You must register for both courses in the same semester

**CHMY 323 Organic Chemistry II: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 321 and CHMY 322. (F, Sp) CO-REQUISITE: Concurrent enrollment in CHMY 324. The second semester of the two-semester professional sequence in organic chemistry. Topics include the characterization of organic compounds by Mass Spectrometry as well as IR and NMR spectroscopy. Reactions, including mechanisms, of alcohols, ethers, amines, arenes, aldehydes, ketones, enolates, carboxylic acids and carboxylic acid derivatives are covered in depth. Concurrent enrollment in CHMY 324 is required to enroll in CHMY 323. You must be enrolled in both courses in the same semester

**CHMY 324 Organic Chemistry II Lab: 1 Credits (1 Lab)**

PREREQUISITE: CHMY 322. The lab to accompany CHMY 323. Enrollment in CHMY 323 is required to enroll in CHMY 324. You must enroll in both courses in the same semester

**CHMY 331 Honors Organic Chemistry I: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 151 and CHMY 153 or consent of instructor. CHMY 331 is the first of a two-semester honors sequence in organic chemistry. Topic coverage parallels CHMY 321, but at an accelerated pace with in-depth coverage of physical organic chemistry, stereochemistry, synthetic organic chemistry, spectroscopy, and nomenclature

**CHMY 332 Honors Organic Chemistry I Lab: 1 Credits (1 Lab)**

PREREQUISITE: C- or better in CHMY 144 or CHMY 154. The lab to accompany CHMY 331. Enrollment in CHMY 331 is required to enroll in CHMY 332

**CHMY 333 Honors Organic Chemistry II: 3 Credits (3 Lec)**

PREREQUISITE: A grade of better than a C in CHMY 331 or consent of instructor. CO-REQUISITE: CHMY 334. CHMY 333 is the second semester of the two-semester honors sequence in organic chemistry. Topic coverage parallels CHMY 323, with more in-depth coverage of mechanisms and more emphasis on retrosynthetic analysis and on solving multi step synthesis problems. Enrollment in CHMY 334 is required to enroll in CHMY 333

**CHMY 334 Honors Organic Chemistry II Lab: 1 Credits (1 Lab)**

PREREQUISITES: C- or better in CHMY 144 or CHMY 154. The lab to accompany CHMY 333. Enrollment in CHMY 333 is required to enroll in CHMY 334.

**CHMY 340 Environmental Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 321 and CHMY 322 or CHMY 211 and CHMY 212. (Sp) This course will provide students with a fundamental understanding of environmental chemistry appropriate for a mid-level undergraduate science major, and serve as a necessary introduction for students interested in applying chemistry to understanding and solving environmental and sustainability issues. Because this is a large and complex field, the material will be introductory in nature. However, each student will be required to do one independent project, either a paper or class presentation, on a topic of their choice. This will allow them, through directed self-study, to go into greater detail on a topic interest to them. Potential topic suggestions are provided at the end of the syllabus, but the students will be free to choose issues outside this list. Rather than in class exams, we will instead assign a regular series of challenging problem sets that required students to integrate multiple concepts, or multiple pieces of information. Assigned reading, especially literature outside the adopted text book, will also be the subject of in class discussion, and participation will be emphasized. A series of discussion questions will be included in advance so that the students can arrive prepared for discussion. Ultimately, this course offers the opportunity for students to add depth to their training in chemistry relevant to environmental science, and expand their knowledge of fundamental aspects of environmental chemistry of interest to them. Additionally, the course will enhance further development of written and oral communication skills and provide students an opportunity to gain leadership experience and group discussion skills. Optional excursions and in class learning will combine to elevate students' confidence in their professional development and their ability to speak on environmental issues from an informed chemical perspective, regardless of their position on individual environmental issues

**CHMY 361 Elements of Physical Chemistry: 4 Credits (4 Lec)**

PREREQUISITE: M 161Q or M 172 and PHSX 207, and CHMY 211 or CHMY 323 or CHMY 333. A physical chemistry course directed toward the life sciences, health professions, and agricultural sciences

**CHMY 362 Elements of Physical Chemistry Lab: 1 Credits (1 Lab)**

PREREQUISITE: CHMY 361 can be a prerequisite or co-requisite. The laboratory to accompany CHMY 361

**CHMY 371 Physical Chemistry-Quantum Chemistry and Spectroscopy I: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 143 or CHMY 153 and M 172 and PHSX 222. COREQUISITE: M 273. The first semester of a two-course sequence for science and engineering majors on quantum chemistry, statistical thermodynamics, spectroscopy, classical thermodynamics and kinetics

**CHMY 372 Physical Chemistry Laboratory I: 1 Credits (1 Lab)**

Laboratory to accompany CHMY 371. Fundamental experiments in thermodynamics and kinetics.

**CHMY 373 Physical Chemistry - Kinetics and Thermodynamics: 3 Credits (2 Lec, 1 Other)**

PREREQUISITE: CHMY 143 or CHMY 153 and M 172 and PHSX 222. The second semester of a two-course physical chemistry sequence for science/engineering majors. Students should take both semesters of the sequence -

**CHMY 374 Physical Chemistry Lab II: 2 Credits (1 Lec, 1 Lab)**

PREREQUISITE: CHMY 371  
COREQUISITE: CHMY 373. The advanced laboratory to accompany CHMY 373. In-depth experiments and data analysis. Required of all chemistry majors who take CHMY 373. While required for the Professional Option, CHMY 372 is not required as a prerequisite for CHMY 374 .

**CHMY 394 Seminar/Workshop: 1 Credits (1 Other)**

PREREQUISITE: CHMY 294 or BCH 294. Developing student presentation skills thru the preparation and presentation of a group 50-minute talk on a chemical topic of current interest. Career planning and resume preparation. May be repeated once. Cross-Listed with BCH 394

**CHMY 401 Advanced Inorganic Chemistry: 3 Credits (2 Lec, 1 Other)**

PREREQUISITE: CHMY 323 and CHMY 324 or CHMY 333 and CHMY 334. (F) A systematic presentation of atomic structure and chemical bonding with emphasis on properties, structure, and the reactions of representative members of the various families of the periodic table

**CHMY 404 Advanced Inorganic Techniques: 3 Credits (3 Lab)**

PREREQUISITE: CHMY 401. (Sp) CHMY 404 connects fundamental concepts taught in the Advanced Inorganic Chemistry lecture class (CHMY 401) with experimental case-studies in inorganic chemistry providing a wide-range of modern techniques used for inorganic synthesis and characterization

**CHMY 415 Structure and Bonding in Inorganic Chemistry: 3 Credits (3 Lec)**

PREREQUISITES: CHMY 401 or CHMY 501  
Students in this class will build on the foundations of inorganic chemistry covered in CHMY 401/501. The focus will be on applying this foundational material to understanding modern frontiers of inorganic chemistry. We will focus largely on solid state and materials chemistry, d-transition metal organometallic chemistry, and the inorganic chemistry of biological systems. Students will gain additional exposure to physical techniques used in modern inorganic chemistry. Readings will come from both a textbook and the chemical literature.

**CHMY 417 Synthetic Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 323. Organic and inorganic reaction chemistry for advanced students. Modern reagents and transformations are treated in detail, along with relevant theoretical and mechanistic considerations

**CHMY 421 Advanced Instrument Analysis: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: CHMY 311 and CHMY 361 or CHMY 371. An advanced analytical chemistry course which covers modern instrumental methods based on spectrochemical and electrochemical principles. This course is offered every other year in the spring of odd numbered years

**CHMY 490R Undergraduate Research: 1-6 Credits (1 Other)**

PREREQUISITE: Consent of instructor. Directed undergraduate research/creative activity which may culminate in a research paper, journal article, or undergraduate thesis. Course will address responsible conduct of research. May be repeated  
Repeatable up to 12 credits.

**CHMY 491 Structure and Bonding in Inorganic Chemistry: 1-4 Credits ( )**

Course prerequisites as determined for each offering.

**CHMY 492 Independent Study: 1-4 Credits (1-4 Other)**

PREREQUISITE: Junior standing, consent of instructor, and approval of department head. Directed research and study on an individual basis Repeatable up to 6 credits.

**CHMY 494 Seminar/Workshop: 1 Credits (1 Other)**

PREREQUISITE or COREQUISITE: CHMY 394 or BCH 394. Senior capstone course. Taught in collaboration with departmental Honors Thesis, CHMY 499. The chemistry/biochemistry research undergraduate experience constitutes a synthesis of our (bio)chemistry class room and laboratory education. The projects are orally presented in seminar form, discussed on the basis of acquired knowledge, and analyzed using stringent scientific methods and criteria. A complete personal resume is prepared. May be repeated once. Cross-listed with BCH 494

**CHMY 499 Senior Thesis/Capstone: 1 Credits (1 Lec)**

PREREQUISITE: CHMY 490R or BCH 490R (minimum of 3 cr.) Thesis format and style will be illustrated, discussed, and monitored. Draft portions of manuscripts are to be completed on a regular schedule. Required of all candidates for departmental honors. Cross-listed with BCH 499

**CHMY 501 Advanced Inorganic Chemistry: 3 Credits (3 Lec)**

A systematic presentation of atomic structure and chemical bonding with emphasis on properties, structure, and the reactions of representative members of the various families of the periodic table. Department of Chemistry Biochemistry.

**CHMY 505 Critical Concepts in Chemistry: 3 Credits (2 Lec, 2 Lab)**

PREREQUISITE: CHMY 121IN or equivalent. Course explores new learning strategies that encourage discovery-based learning. Class will explore ways to use computer technology to engage students in discovery-based learning

**CHMY 506 Integrating Computers into Laboratory Instruction: 2 Credits (1 Lec, 1 Lab)**

PREREQUISITE: CHMY 142 or CHMY 143 or CHMY 121 or equivalent. (Su) One year introductory chemistry course (CHMY 142 and 143) and coursework or experience equivalent to one semester physical chemistry (CHMY 361). A baccalaureate degree and experience teaching science at the secondary level are required. The course will examine and discuss fundamental and critical concepts in chemistry. A practical laboratory component will enable students to develop laboratory and/or demonstration projects for each concept. Individual student-generated presentations are a key course component. Offered Summer

**CHMY 513 Computational Chemistry: 3 Credits (1 Lec, 2 Lab)**

PREREQUISITES: CHMY 153 or CHMY 361. The course provides a comprehensive overview of computational chemistry methods with cursory, but adequate treatment of related theory. Thus, basic quantum or theoretical chemistry background is assumed. The focus of the lectures and hands-on laboratory exercises will be using computational tools correctly and creatively as well as comparing and contrasting theoretical methods and experimental results from literature. The textbook is used to provide a good background of the relevant theoretical concepts, as needed. Each student will work on an individual project throughout the class that is preferably from past experimental research experience or current graduate thesis topics

**CHMY 515 Structure and Bonding in Inorganic Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 401. Spectroscopy, structure, and bonding of coordination and organometallic compounds

**CHMY 516 Mechanisms and Dynamics in Inorganic Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 401. Mechanisms and dynamics of the reactions of coordination and organometallic compounds

**CHMY 517 Synthetic Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 323. Organic and inorganic reaction chemistry for advanced students. Modern reagents and transformations are treated in detail, along with relevant theoretical and mechanistic considerations. Department of Chemistry & Biochemistry

**CHMY 523 Organic Reaction Mechanisms: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 323

COREQUISITE: CHMY 533. A problem solving course concentrating on analyzing organic reactions and transformations via electron-pushing mechanisms. Problems chosen will be from the current chemical literature. Designed for incoming graduate students and upper-class undergraduates who want to learn or brush up on their electron-pushing skills

**CHMY 524 Mass Spectrometry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 371 or CHMY 361. Mass spectrometric methods of analysis. Methods for ionization of samples in the gas, liquid and solid phases. Proteomics applications. Cross-listed with BCHM 524

**CHMY 525 Chemical Reactions: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 373. Treatment of complex chemical equilibria, kinetics, and mass transport in the solution and gas phases with respect to their effects on methods of chemical analysis

**CHMY 526 Solution NMR Spectroscopy: Practical Applications to the Structural Determination of Small Molecules: 3 Credits (3 Lec)**

(F, Sp) This course integrates hands-on practical sessions using the NMR spectrometers of MSU Core NMR facility, with instructor lectures. The goal is to enable students to master the canonical NMR experiments employed for structural characterization of small molecules and measurements of molecular dispersion and reaction kinetics. Students will be paired to work together on the spectrometers (300 MHz, 400 MHz, 500 MHz, or 600 MHz NMRs) and will learn, by conducting in real time, a range of commonly used NMR experiments for small molecule characterization and reaction kinetics. The students will gain practical knowledge on how to set-up different NMR experiments and how to run the NMR spectrometers. NMR experiments that students will become proficient in, will range from simple 1D <sup>1</sup>H NMR to more sophisticated 2D heteronuclear (<sup>1</sup>H, <sup>13</sup>C, <sup>15</sup>N) experiments including HSQC, HMBC, 2D-NOESY, TOCSY, J-resolved spectroscopy, among others. Students should have some familiarity with analytical methods, spectroscopy, and elements of physical chemistry. Students should have a background in basic chemistry, including: the atoms, the elements and the periodic table; the structure of organic molecules (functional groups, stereochemistry); as well as in basic physical chemistry, including some basic knowledge about the spectroscopy (energy levels, photon, frequency).

**CHMY 527 Analytic Optical Spectroscopy: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 371. Use of optical spectroscopic methods for chemical analysis

**CHMY 533 Physical Organic Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 417. A semi-quantitative description of the mechanisms of organic reactions. Topics include M.O. theory, orbital symmetry, addition and elimination reactions, the kinetics and thermodynamics of organic reactions, solvent effects, etc

**CHMY 535 Reagent Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 417. A thorough study of synthetic processes, methodologies and reagents

**CHMY 540 Organic Synthesis: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 533 and CHMY 535. A thorough study of strategies for the synthesis of complex natural products

**CHMY 551 Organic Structure Elucidation: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 417. Spectroscopic structure elucidation of small organic molecules. Techniques to be discussed include 1-D and 2-D NMR spectroscopy, UV, IR, MS, and Raman spectroscopies. Emphasis will be on interpreting spectra to deduce the structure of the compound in question

**CHMY 554 Organometallic Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 321, CHMY 323 and CHMY 553. Application of organometallic chemistry to organic transformations

**CHMY 557 Quantum Mechanics: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 373 or equivalent. Applications of quantum mechanics to molecules and spin systems

**CHMY 558 Classical & Stat Thermodynamic: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 373 or equivalent. Classical & statistical thermodynamics applied to chemical systems

**CHMY 559 Kinetics & Dynamics: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 373 or equivalent. Chemical kinetics, theories of reaction rates, molecular reaction dynamics, with applications to Chemical reactions in the gas phase, on surfaces, and in solution

**CHMY 560 Symmetry, Orbitals, and Spectroscopy: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 373. Group theory with applications, semi-empirical and ab initio calculations, vibrational and electronic spectroscopy, and their interrelationship will be covered

**CHMY 564 Adv Quantum Chemistry: 3 Credits (3 Lec)**

PREREQUISITE: CHMY 557 or equivalent. Time independent and time dependent quantum mechanics with application to chemical bonding and molecular spectroscopy

**CHMY 575 Professional Paper: 1-6 Credits (1-6 Other)**

PREREQUISITE: Consent of instructor. A research or professional paper or project dealing with a topic in the field. The topic must have been mutually agreed upon by the student and his or her major advisor and graduate committee. Cross-Listed with BCH 575  
Repeatable up to 6 credits.

**CHMY 587 Exploring Chemistry for Teachers: 3 Credits (3 Lec)**

(Su) The course will lead to a greater understanding of chemical concepts, provide resources and ideas for class activities, and advice from fellow teachers with the ultimate goal of enhancing your teaching abilities—and giving you confidence in your understanding of the material. The level of content is appropriate for either a stand-alone class in high school or as a section in an integrated science class. Students of this course will gain insight to how topics in chemistry are linked together and how they can all be applied to explain other areas of science and topics of public concern. Offered Summer.

**CHMY 588 Professional Development: 1-3 Credits (1-3 Lec)**

PREREQUISITE: Graduate standing; teaching experience and/or current employment in a school or organization; and consent of instructor and Dean of Graduate Studies. Courses offered on a one-time basis to fulfill professional development needs of in service educators. A specific focus is given to each course which is appropriately subtitled. May be repeated  
Repeatable up to 3 credits.

**CHMY 589 Graduate Consultation: 1-3 Credits (3 Other)**

PREREQUISITE: Master's standing and approval of the Dean of Graduate Studies. This course may be used only by students who have completed all of their course work (and thesis, if on a thesis plan) but who need additional faculty or staff time or help

**CHMY 590 Master's Thesis: 1-10 Credits (1-10 Other)**

PREREQUISITE: Master's standing  
Repeatable up to 99 credits.

**CHMY 591 Special Topics: 1-4 Credits ()**

Course prerequisites as determined for each offering.

**CHMY 592 Independent Study: 1-3 Credits (1-3 Other)**

PREREQUISITE: Graduate standing, consent of instructor, approval of department head and Dean of Graduate Studies. Directed research and study on an individual basis  
Repeatable up to 3 credits.

**CHMY 593 Kinetics, Equilibrium & Thermodynamics for Teachers: 3 Credits (2 Lec, 1 Other)**

(Sp) Equilibrium, Thermodynamics, and Kinetics explain why reactions stop where they do, why they get hot or cold, and how fast they occur. This course is designed to help teachers of science bolster their background in equilibrium, thermodynamics, kinetics as well as provide assistance in the teaching of these topics. A classroom population represents a distribution of learning styles and a goal of this course is to provide a variety of instructional tools for teachers to utilize in their classrooms. Offered Spring.

**CHMY 594 Seminar: 1 Credits (1 Other)**

(Su) Course prerequisites as determined for each offering. Topics offered at the graduate level which are not covered in regular courses. Students participate in preparing and presenting discussion material. Cross-Listed with BCH 594. Offered Summer.  
Repeatable up to 4 credits.

**CHMY 595 Chemistry of the Environment for Teachers: 3 Credits (2 Lec, 1 Lab)**

(Su) This course is designed to familiarize existing secondary teacher (ideally 8th and 9th grade) with basic general science and chemistry concepts of the environment, including water, air and Earth - as well as to provide opportunities to enrich these chemistry concepts through applications and examples. Since this course will be building upon basic chemistry concepts, teachers taking this course should have taken general chemistry at the undergraduate level, or the equivalent. Offered Summer.

**CHMY 596 Exploring Organic Chemistry for Teachers: 3 Credits (1 Lec, 1 Lab, 1 Other)**

(F) This course is for teachers of science interested in refreshing and/or increasing organic chemistry knowledge for application in the high school classroom. Weekly discussion topics cover course content and teaching ideas specific to organic chemistry. Exams include a Teaching Organic Chemistry Problem. An optional teaching project resulting in an organic chemistry unit of study is available. Offered Fall.

**CHMY 597 Exploring Biochemistry I for Teachers: 3 Credits (2 Lec, 1 Lab)**

() Offered Summer, odd years. The course will consider the reactions of the principle biochemical molecules (carbohydrates, lipids, proteins, and nucleic acids) with additional emphasis on biomedical topics. The primary goal of this course is to promote critical thinking about important, current health issues and to examine the role of laboratory modules in teaching these concepts. General biochemistry principles will be presented to understand the diseases under review. Written material will be provided on advanced topics. Offered Spring.

**CHMY 598 Exploring Biochemistry: Metabolism for Teachers: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: CHMY 597. (Su) Offered Summer, even years. This course is designed to serve as the second semester of a two-semester sequence of biochemical principles. The course will build on topics covered in CHMY 597 (Exploring Biochemistry I for Teachers) such as carbohydrates, lipids, proteins and nucleic acids. The proposed course will investigate the metabolism of each of these biological molecules while exploring applications of these topics to a classroom setting. The textbook will be used as a basis for the course but students will be required to utilize materials from various resources including chapter summaries, related internet websites, scientific journals, and material compiled on the students part. Offered Summer

**CHMY 599 An Atoms-First Primer for AP/IB Chemistry Teachers: 3 Credits (1 Lec, 1 Lab, 1 Other)**

() Offered Fall, odd years. This course is designed to introduce teachers of Advanced Placement (AP) or International Baccalaureate (IB) Chemistry courses to an Atoms-First pedagogy in the teaching of their courses. Students will be exposed to the an Atoms First approach to teaching AP or IB chemistry which emphasizes a pedagogy of building chemical foundations before moving onto more difficult topics. Students will finish by developing lesson plans using this pedagogy to teach AP or IB chemistry at the high school level. Offered Fall.

**CHMY 689 Grad Research/Instruction: 1-3 Credits (1-3 Lec)**

PREREQUISITE: Graduate standing  
COREQUISITE: CHMY 590 or CHMY 690. Classroom instruction associated with directed graduate research/creative activity projects

Repeatable up to 3 credits.

**CHMY 690 Doctoral Thesis: 1-10 Credits (1-10 Other)**

PREREQUISITE: Doctoral standing  
Repeatable up to 99 credits.