

## DEPARTMENT OF CHEMISTRY

### *College of the Sciences and Mathematics*

(See also: Pre-Medical Program (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/pre-medical-program/>) and Pharmaceutical Product Development Program (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/pharmaceutical-product-development/>))

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Department of Chemistry (<http://www.wcupa.edu/chemistry/>)  
Mahrukh Azam ([mazam@wcupa.edu](mailto:mazam@wcupa.edu)), *Chairperson*  
Melissa Cichowicz ([mcichowicz@wcupa.edu](mailto:mcichowicz@wcupa.edu)), *Assistant Chairperson*

The Department of Chemistry has been approved by the American Chemical Society's Committee on Professional Training since 1972. Graduates of the B.S. in Chemistry program and the B.S. in Biochemistry program who meet the necessary standards receive ACS certification. Graduates of the B.S. in Forensic and Toxicological Chemistry receive FEPAC certification.

The Department of Chemistry offers four undergraduate degree programs:

- The **B.S. in Chemistry program** (approved by the American Chemical Society [ACS]) provides a rigorous scientific foundation in all major areas of chemistry. This degree prepares the graduate for a career in a wide variety of chemically related areas including the chemical, petroleum, environmental, and pharmaceutical sectors. In addition, it serves as a basis for graduate and professional study leading to higher level industrial positions, teaching at the college level, or involvement in technical aspects of related fields such as law.
- The **B.S. in Biochemistry program** (approved by the American Chemical Society [ACS]) provides a comprehensive background in the major areas of chemistry with an emphasis in biochemistry. Students awarded this degree will be qualified for employment opportunities in chemistry and biochemistry. The program also prepares students for graduate study in chemistry and in biochemistry.
- The **B.S. in Chemistry-Biology program** provides the core courses required for admission to schools of medicine, dentistry, and veterinary medicine as well as schools of optometry, podiatry, chiropractic, and physical therapy. It also enables the student to pursue a career in biochemistry, molecular biology, and medicinal chemistry.
- The **B.S. in Forensic and Toxicological Chemistry program** (accredited by Forensic Science Education Programs Accreditation Commission [FEPAC]) prepares students for careers in criminalistics and toxicology. The program also serves as a basis for graduate study and specialization in these fields. A one-semester internship in a toxicology or forensic-chemistry laboratory is required for this program. Only those students who successfully complete the internship interview and pass the safety exam will obtain this internship. (A background check and additional site-specific requirements may also be necessary.)

Majors in the four B.S. programs should consult the Department of Chemistry handbook and their advisor for current requirements, particularly regarding internships. A grade of C- or better is necessary in all required science and mathematics courses.

### Undergraduate Research and Internship Programs

Although internships are not a mandatory part of all chemistry programs, they are available to majors on a selective basis. Students receive varying amounts of credit based on the number of hours spent in a work situation and on the nature of the academic work during the internship or research. Credit varies from one to 12 credits. The

number of research or internship credits taken may be limited by the department.

## Programs

### Majors

- B.S. in Biochemistry (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/chemistry/biochemistry-bs/>)
- B.S. in Chemistry (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/chemistry/chemistry-bs/>)
- B.S. in Chemistry-Biology (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/chemistry/chemistry-biology-bs/>)
- B.S. in Forensic and Toxicological Chemistry (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/chemistry/forensic-toxicological-chemistry-bs/>)

### Minor

- Chemistry (<http://catalog.wcupa.edu/undergraduate/sciences-mathematics/chemistry/chemistry-minor/>)

### Graduate Opportunities

See the graduate catalog for more information on the Chemistry programs. (<http://catalog.wcupa.edu/graduate/sciences-mathematics/chemistry/>)

## Policies

- See undergraduate admissions information. (<http://catalog.wcupa.edu/general-information/admissions-enrollment/undergraduate-admissions/>)
- See academic policies. (<http://catalog.wcupa.edu/undergraduate/academic-policies-procedures/>)

All undergraduate students are held to the academic policies and procedures outlined in the undergraduate catalog. Students are encouraged to review departmental handbooks for program tips, suggested course sequences, and explanations of procedures. When applicable, additional policies for specific department programs may be listed below.

## Faculty

### Professors

Mahrukh Azam ([mazam@wcupa.edu](mailto:mazam@wcupa.edu)) (2004)  
Chairperson, Chemistry  
B.S., Punjab University; M.S., Quaid-e-Azam University; M.S., Ph.D., Seton Hall University

Roger Barth ([rbarth@wcupa.edu](mailto:rbarth@wcupa.edu)) (1985)  
B.A., La Salle University; M.A., Ph.D., Johns Hopkins University

Felix E. Goodson ([fgoodson@wcupa.edu](mailto:fgoodson@wcupa.edu)) (1998)  
A.B., Princeton University; Ph.D., University of California, Berkeley

Monica Joshi ([mjoshi@wcupa.edu](mailto:mjoshi@wcupa.edu)) (2010)  
B.Sc., St. Francis Degree College for Women (India); M.Sc., Osmania University (India); Ph.D., Florida International University

Kurt W. Kolasinski ([kkolasinski@wcupa.edu](mailto:kkolasinski@wcupa.edu)) (2006)  
B.S., University of Pittsburgh; Ph.D., Stanford University

Timothy K. Starn ([tstarn@wcupa.edu](mailto:tstarn@wcupa.edu)) (1996)  
B.S., Ph.D., Indiana University

John R. Townsend ([jtownsend@wcupa.edu](mailto:jtownsend@wcupa.edu)) (1998)  
B.A., University of Delaware; M.S., Ph.D., Cornell University

### Associate Professors

Melissa B. Cichowicz ([mcichowicz@wcupa.edu](mailto:mcichowicz@wcupa.edu)) (1986)  
Assistant Chairperson, Chemistry  
B.S., St. Joseph's College; Ph.D., University of Maryland

Blaise F. Frost (bfrost@wcupa.edu) (1989)  
B.A., Yankton College; M.S., Ph.D., University of South Dakota

Jingqiu Hu (jhu@wcupa.edu) (2014)  
B.S., M.S., Nanjing University; Ph.D., Boston University

Constantinos Pistos (cpistos@wcupa.edu) (2015)  
B.Sc. Aristotle University of Thessaloniki, Thessaloniki, Greece; M.Sc.,  
Ph.D. National and Kapodistrian University of Athens, Athens, Greece

James R. Pruitt (jpruitt@wcupa.edu) (2011)  
B.S., Ph.D., University of California

Thomas R. Simpson (tsimpson2@wcupa.edu) (2016)  
Director, Pharmaceutical Product Development  
B.S., Allegheny College; M.S., Ph.D., University of Rochester

## Instructors

David Dehm (ddehm@wcupa.edu) (2015)  
B.S., M.S., SUNY Oswego; Ph.D., University of Cincinnati

Mark Shuman (mshuman@wcupa.edu) (2015)  
B.S., Georgetown University; Ph.D., University of Pennsylvania

## Courses

### CHE

#### **CHE 100. Concepts of Chemistry. 3 Credits.**

LEC (2), LAB (1)

A broad survey course with a laboratory experience that seeks to develop an understanding of the field of chemistry through inquiry. Basic competence in scientific methods and procedures will be obtained by observing chemical reactions and studying the chemical and physical properties of a variety of compounds.

Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall.

#### **CHE 101. Fundamentals of Chemistry. 3 Credits.**

A mathematically oriented course for students who intend later to take CHE 103 but whose science and mathematics backgrounds are judged by a pretest to need remediation.

Typically offered in Fall.

#### **CHE 103. General Chemistry I. 3 Credits.**

Basic laws and theories of chemistry, including atomic structure, chemical bonding, oxidation-reduction, solutions, and ionic equilibria. Correlations of chemical principles and their application to modern descriptive chemistry. CHE 103 must precede CHE 104.

Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall, Spring & Summer.

#### **CHE 104. General Chemistry II. 3 Credits.**

Basic laws and theories of chemistry, including atomic structure, chemical bonding, oxidation-reduction, solutions, and ionic equilibria. Correlations of chemical principles and their application to modern descriptive chemistry.

Pre / Co requisites: CHE 104 requires prerequisite of CHE 103.

Typically offered in Fall & Spring.

#### **CHE 107. General Chemistry for Allied Health Sciences. 4 Credits.**

A one-semester treatment of the fundamentals of chemistry, including atomic structure and bonding, types of reactions, kinetics, equilibrium, and thermodynamics. May not be taken as a chemistry major elective. CRL 107 may be taken concurrently or after CHE 107.

Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall, Spring & Summer.

#### **CHE 160. The Chemistry of Beer. 3 Credits.**

An introduction to the chemistry of beer, including its properties, ingredients, production, and origins. The chemistry and biochemistry of alcohol will also be covered.

Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Spring.

#### **CHE 199. Transfer Credits. 1-10 Credits.**

Transfer Credits.

Repeatable for Credit.

#### **CHE 230. Introduction to Organic and Biological Chemistry. 3 Credits.**

A terminal course in fundamentals of organic chemistry. Structural theory of organic molecules, organic synthesis, and biological applications. May not be taken as a chemistry major or minor elective.

Pre / Co requisites: CHE 230 requires a prerequisite of CHE 104 or CHE 107 with a C- or better.

Typically offered in Fall.

#### **CHE 231. Organic Chemistry I. 4 Credits.**

A unified conceptual introduction to organic molecular structure. Topics discussed will include structure of the atom, orbital and molecular bonding theory, nomenclature of classes of molecules, elementary molecular orbital theory, stereochemistry, nucleophilic substitution, elimination, resonance, and acid-base concepts. These concepts will be applied to the chemistry of hydrocarbons, alkyl halides, alcohols, and simple systems.

Pre / Co requisites: CHE 231 requires a prerequisite of CHE 104.

Typically offered in Fall, Spring & Summer.

#### **CHE 232. Organic Chemistry II. 3 Credits.**

A survey of the classes of organic reaction from a mechanistic deductive approach. Topic will include nucleophilic and electrophilic substitution, reaction of carbonyl compounds, elimination, aromatic substitution, molecular rearrangements, oxidation reduction reactions, carbanion and amine chemistry. These reactions are applied to the remaining classes of organic compounds not covered in CHE 231.

Pre / Co requisites: CHE 232 requires a prerequisite of CHE 231.

Typically offered in Fall, Spring & Summer.

#### **CHE 310. Introductory Biochemistry. 3 Credits.**

The chemical nature of biological phenomena is presented. Particular emphasis is placed on the metabolic pathways and the enzymes responsible for these processes with applications to nutrition. May not be taken as a chemistry major or minor elective.

Pre / Co requisites: CHE 310 requires a prerequisite of CHE 230 or CHE 231.

Typically offered in Spring & Summer.

#### **CHE 321. Analytical Chemistry I. 3 Credits.**

Fundamental principles of analytical chemistry. Theory of gravimetric and volumetric methods of analysis. Lab: CRL 321.

Pre / Co requisites: CHE 321 requires a prerequisite of CHE 104.

Typically offered in Fall, Spring & Summer.

#### **CHE 333. Advanced Organic Chemistry. 3 Credits.**

An advanced mechanistic study of organic compounds, functional groups, and their reactions. Spectroscopic characterization of organic molecules will also be covered.

Pre / Co requisites: CHE 333 requires prerequisite of CHE 232.

Typically offered in Fall.

#### **CHE 341. Physical Chemistry I. 4 Credits.**

An introduction to physical chemistry including ideal and real gases, kinetic theory, statistical mechanics, intermolecular interactions, transport phenomena, three laws of thermodynamics and their application, chemical and phase equilibria, mixtures of electrolytes and nonelectrolytes, electrochemistry, chemical kinetics, transition state theory, surface chemistry, catalysis, reaction dynamics and photochemical kinetics.

Pre / Co requisites: CHE 341 requires prerequisites of CHE 104, MAT 162, and PHY 180.

Typically offered in Fall.

#### **CHE 342. Physical Chemistry II. 3 Credits.**

Introduction to quantum mechanics; model quantum systems including free particle, harmonic oscillator, rigid rotor and particle in the box; atomic structure and spectroscopy; quantum chemical approach to bonding; rotational, vibrational and electronic spectroscopy of molecules; dynamics of photochemistry including photosynthesis; nonlinear spectroscopy; and femtochemistry.

Pre / Co requisites: CHE 342 requires prerequisites of CHE 104 and CHE 341 and MAT 161 and MAT 162 and PHY 170 and PHY 180.

Typically offered in Spring.

#### **CHE 343. Chemistry and the Law. 3 Credits.**

The goal of the course is to provide the student with an introduction to the American criminal justice system and role of forensic evidence and expert testimony in that system. At the completion of the course, the students shall be able to compare and contrast the adversarial process (law) and the scientific method (science), to identify criminal offenses and procedural requirements within a set of facts, to describe the trial process and the role of the forensic scientist in that process, to explain the admissibility of scientific evidence, and to explain and defend a forensic case file. The course will include lectures, discussions, reading assignments, and class participation.

Typically offered in Fall.

**CHE 345. Physical Chemistry for the Life Sciences. 3 Credits.**

A survey of the fundamental topics in physical chemistry with applications to biology and medicine. Primarily for biology, chemistry-biology, and preprofessional majors.

Pre / Co requisites: CHE 345 requires prerequisites of CHE 232; MAT 161 or MAT 145; and PHY 140 or PHY 180.

Typically offered in Fall.

**CHE 361. Forensic Chemistry I. 3 Credits.**

This course is a precursor to CHE 371. It is a survey of forensic science course designed to expose students to the full breadth of forensic science disciplines in a full-service crime laboratory.

Students will also discuss professional practices and ethical expectations of a forensic scientist.

The course content is designed for chemistry majors with special emphasis on developing foundational scientific writing skills needed for upper level courses.

Pre / Co requisites: CHE 361 requires prerequisites of CHE 104 and BIO 110.

Gen Ed Attribute: Writing Emphasis.

Typically offered in Spring.

**CHE 371. Forensic Chemistry II. 3 Credits.**

The course provides upper level undergraduate chemistry students basic and advanced concepts of forensic science. The course content is designed to provide a foundational understanding of the chemistry of materials routinely encountered as evidence in a forensic lab and the techniques used to analyze them. Those students taking the lab course associated with this lecture course will practice the principles learnt in this course.

Pre / Co requisites: CHE 371 requires prerequisites of CHE 232 and CHE 321.

Typically offered in Fall.

**CHE 403. Chemistry of the Environment. 3 Credits.**

The chemistry of the atmosphere, hydrosphere, and biosphere; man's impact on these areas. May also be offered with lab.

Pre / Co requisites: CHE 403 requires prerequisite of CHE 104.

Typically offered in Spring.

**CHE 409. Descriptive Inorganic Chemistry. 3 Credits.**

Emphasis is on the periodic properties of the representative elements, the structure of inorganic solids, the chemistry of aqueous and nonaqueous solutions, and the study of some transition metals. Lanthanides and actinides also are studied.

Pre / Co requisites: CHE 409 requires prerequisites of CHE 104 and CRL 104.

Typically offered in Fall.

**CHE 410. Advanced Independent Study or Research. 2-6 Credits.**

Taken under the direct supervision of a faculty member. May be taken for two semesters for a total of six credits.

Typically offered in Fall & Spring.

Repeatable for Credit.

**CHE 411. Advanced Inorganic Chemistry. 3 Credits.**

Structure and properties of the elements and inorganic compounds from a theoretical point of view. Atomic structure and the periodic law; molecular structure and bonding, including symmetry and MO theory; structure, bonding, and reactivity of transition-element compounds and main group compounds; acid-base chemistry.

Pre / Co requisites: CHE 411 requires prerequisite of CHE 341.

Typically offered in Spring.

**CHE 418. Chemical Information. 1 Credit.**

Instruction in the use of a modern chemical library, reference and data acquisition, synthetic procedures, and computer data bases.

Pre / Co requisites: CHE 418 requires prerequisite of CHE 231.

Typically offered in Fall.

**CHE 424. Advanced Analytical Chemistry. 3 Credits.**

Basic principles of applied instrumental analysis. Special emphasis on the use of spectrophotometric and electroanalytical instrumentation.

Pre / Co requisites: CHE 424 requires prerequisites of CHE 321 and CHE 341 and co-requisite of CHE 342.

Typically offered in Spring.

**CHE 433. Advanced Topics in Chemistry. 3 Credits.**

A topic of current interest in chemistry. Topic to be announced before registration.

Pre / Co requisites: CHE 433 requires a prerequisite of CHE 341.

Typically offered in Fall & Spring.

Repeatable for Credit.

**CHE 436. Polymer Chemistry. 3 Credits.**

Polymerization kinetics, rheology of polymer melts, crystallization parameters, and monomer reactivity in copolymerization.

Pre / Co requisites: CHE 436 requires prerequisite of CHE 232.

Typically offered in Spring.

**CHE 450. Internship in Chemistry. 1-12 Credits.**

A full- or part-time work-study appointment in a hospital, or a commercial, governmental, or industrial laboratory supervised jointly by an on-site supervisor and Department of Chemistry faculty member.

Consent: Permission of the Department required to add.

Typically offered in Fall & Spring.

Repeatable for Credit.

**CHE 451. Internship in Forensic Chemistry. 1-12 Credits.**

A full- or part-time work-study appointment in a clinical, commercial, governmental, or industrial laboratory supervised jointly by an on-site supervisor and a Department of Chemistry faculty member. The analytical methodology in the laboratory will include techniques applicable to forensic toxicology and/or criminalistics.

Consent: Permission of the Department required to add.

Typically offered in Fall & Spring.

**CHE 452. Internship in Chemistry-Biology. 6-12 Credits.**

This course gives the student exposure to and hands-on experience in the field of biomedical research. Intended to be a full-time appointment in a hospital, medical school, or research institute, it may be modified to be part-time to better meet a student's needs. Supervised jointly by an on-site supervisor and a Department of Chemistry faculty member. The analytical methodology in the laboratory will include techniques applicable to biomedical research.

Pre / Co requisites: CHE 452 requires prerequisites of CHE 232 and CHE 471 and BIO 357.

Consent: Permission of the Department required to add.

Typically offered in Fall & Spring.

Repeatable for Credit.

**CHE 460. Advanced Organic Spectroscopy. 3 Credits.**

An advanced course in organic spectroscopy dealing with IR, NMR, and MS techniques. Other techniques also may be covered.

Pre / Co requisites: CHE 460 requires prerequisites of CHE 232 and CHE 341 or CHE 345.

Typically offered in Fall.

**CHE 465. Forensic Microscopy. 3 Credits.**

A lecture and practical study of the various microscopic techniques used to analyze various materials relevant to forensic investigations. Topics covered in the course include the properties of light and applications of stereomicroscopy, light microscopy, polarized light microscopy, microchemical tests, scanning electron microscopy and instrumental microscopy.

Pre / Co requisites: CHE 465 requires prerequisite CHE 371 and CRL 371.

Typically offered in Spring.

**CHE 476. Biochemistry I. 3 Credits.**

This course examines the physical and chemical characteristics of proteins, carbohydrates, lipids, and nucleic acids. The bioenergetics of carbohydrate and fat metabolism and the enzymatic control of these processes is a focal point. The bioenergetics of carbohydrate and fat metabolism and the enzymatic control of these processes is a focal point. Nucleic acids in protein synthesis is also covered.

Pre / Co requisites: CHE 476 requires a prerequisite of CHE 232.

Typically offered in Fall, Spring & Summer.

**CHE 477. Biochemistry II. 3 Credits.**

This course is an extension of CHE 476 and considers the biosynthesis and degradation of proteins, carbohydrates, lipids, and nucleic acids. The primary focus is on the interrelationship of these molecules and the pathways involving their metabolism.

Pre / Co requisites: CHE 477 requires prerequisites of CHE 345 and CHE 476.

Typically offered in Spring.

**CHE 479. Chemical Toxicology. 3 Credits.**

A one-semester course in the environmental and physiological aspects of chemical toxicity.

Special emphasis will be placed on documentation, sampling, and verification of materials.

Pre / Co requisites: CHE 479 requires a prerequisite of CHE 232.

Typically offered in Spring.

**CHE 491. Seminar in Chemistry. 1 Credit.**

Oral and poster presentation of papers based on laboratory or library research.

Consent: Permission of the Department required to add.

Typically offered in Fall & Spring.

**CRL****CRL 103. General Chemistry I Lab. 1 Credit.**

Basic laboratory studies in college chemistry utilizing the quantitative approach. Semimicro qualitative analysis and inorganic preparations.

Pre / Co requisites: CRL 103 requires a prerequisite or corequisite CHE 103.

Typically offered in Fall, Spring & Summer.

**CRL 104. General Chemistry II Lab. 1 Credit.**

Basic laboratory studies in college chemistry utilizing the quantitative approach. Semimicro qualitative analysis and inorganic preparations.

Pre / Co requisites: CRL 104 requires a prerequisite of CRL 103 and a prerequisite/corequisite of CHE 104.

Typically offered in Fall, Spring & Summer.

**CRL 107. General Chemistry Lab for Allied Health Sciences. 1 Credit.**

A one-semester laboratory course to complement CHE 107. Basic laboratory techniques, both qualitative and quantitative, will be used to illustrate principles from the lecture. CHE 107 must be taken concurrently or before CRL 107.

Pre / Co requisites: CRL 107 requires a corequisite of CHE 107.

Typically offered in Fall, Spring & Summer.

**CRL 230. Introduction to Organic and Biological Chemistry Lab. 1 Credit.**

A laboratory course to allow students in the environmental health program to gain hands-on experience with the topics and techniques of organic and biochemistry as they apply to the environmental health major.

Pre / Co requisites: CRL 230 requires a prerequisite or corequisite of CHE 230.

Typically offered in Fall.

**CRL 231. Organic Chemistry I Lab. 2 Credits.**

Basic laboratory skills in organic chemistry including classical as well as instrumental techniques. Organic synthesis and modern spectrophotometric methods of identification.

Pre / Co requisites: CRL 231 requires a prerequisite of CRL 104.

Typically offered in Fall, Spring & Summer.

**CRL 232. Organic Chemistry II Lab. 2 Credits.**

Basic laboratory skills in organic chemistry including classical as well as instrumental techniques. Organic synthesis and modern spectrophotometric methods of identification.

Pre / Co requisites: CRL 232 requires a corequisite of CHE 232.

Typically offered in Fall, Spring & Summer.

**CRL 321. Analytical Chemistry I Lab. 2 Credits.**

Practical experience in modern techniques of chemical analysis with emphasis on volumetric and gravimetric methods.

Pre / Co requisites: CRL 321 requires co-requisite of CHE 321.

Typically offered in Fall & Spring.

**CRL 341. Physical Chemistry I Lab. 2 Credits.**

Laboratory course in physical chemistry including computational methods of data analysis, thermodynamics, chemical kinetics, electrochemistry, surface chemistry, electron microscopy and spectroscopy.

Pre / Co requisites: CRL 341 requires prerequisites of CRL 104 and MAT 162 and a prerequisite or corequisite of CHE 341.

Typically offered in Fall.

**CRL 342. Physical Chemistry II Lab. 2 Credits.**

Advanced laboratory course in physical chemistry including quantum chemistry, computer applications, advanced spectroscopy, and x-ray diffraction with an independent project. It is designed to develop discipline-specific oral communication skills.

Pre / Co requisites: CRL 342 requires a prerequisite of CRL 341 and a corequisite of CHE 342.

Gen Ed Attribute: Speaking Emphasis.

Typically offered in Spring.

**CRL 371. Forensic Chemistry Lab. 2 Credits.**

This course is the laboratory component of the forensic chemistry lecture course (CHE 371). The theoretical principles learned in the lecture will be practiced using a combination of different analytical techniques and examples of evidentiary materials. Students will practice fingerprint development, sample preparation techniques, presumptive tests, and instrumental analysis techniques such as spectroscopy, chromatography, and mass spectrometry. The course is also designed to help students become proficient in the science of writing laboratory reports and orally communicating scientific concepts and results of analyses.

Pre / Co requisites: CRL 371 requires a prerequisite of CHE 361 and a corequisite of CHE 371.

Gen Ed Attribute: Speaking Emphasis.

Typically offered in Fall.

**CRL 411. Inorganic Syntheses Lab. 2 Credits.**

A four-hour laboratory course in the synthesis and characterization of inorganic compounds of the main group and the transition elements.

Pre / Co requisites: CRL 411 requires prerequisite of CHE 409 or CHE 411 and co-requisite of CHE 341.

Typically offered in Spring.

**CRL 424. Analytical Chemistry II Lab. 2 Credits.**

Practical experience in the choice and application of instrumental methods of analysis to chemical systems.

Pre / Co requisites: CRL 424 requires prerequisite or co-requisite of CHE 424.

Typically offered in Spring.

**CRL 436. Polymer Chemistry Lab. 2 Credits.**

Synthesis of polymers; molecular, physical, and thermal characterization of polymers. Instrumental methods include X-rays, IR, electron microscopy, and thermal analysis.

Pre / Co requisites: CRL 436 requires prerequisite of CHE 436.

**CRL 476. Biochemistry I Lab. 2 Credits.**

Laboratory exercises in the fundamentals of biochemistry.

Pre / Co requisites: CRL 476 requires co-requisite of CHE 476.

Typically offered in Fall & Spring.

**CRL 477. Biochemistry II Lab. 2 Credits.**

An advanced laboratory course in biochemistry. This course is a practical application of biochemical principles, methods used in forensic DNA typing, and drug metabolite analysis in toxicological matrices.

Pre / Co requisites: CRL 477 requires prerequisites of CHE 476 and CRL 476.

Typically offered in Spring.

**SCI****SCI 102. Electricity with Physical and Biological Applications. 3 Credits.**

An exploration of the physics of electrical circuits, the chemical basis of electricity as the flow of electrons, acid-base and oxidation-reduction reactions in chemical and in living systems, the electrical activity in the human nervous system, and connections between electricity and sensation and locomotion in humans.

Pre / Co requisites: SCI 102 requires that students be Education majors only.

Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall & Spring.