

## CHEMISTRY

<http://www.uvm.edu/~chem/>

### OVERVIEW

The Chemistry Department currently offers graduate programs leading to either the M.S. or Ph.D. in analytical, biological, inorganic, organic, or physical chemistry. In recent years about eight students per year have received the Ph.D. In the Chemistry Department, courses are offered in inorganic chemistry, organometallic chemistry, physical inorganic chemistry, synthetic organic chemistry, physical organic chemistry, heterocyclic chemistry, advanced analytical chemistry, optical spectroscopy, mass spectrometry, electrochemistry, thermodynamics, quantum chemistry, and polymer chemistry.

Upon arrival, new graduate students in Chemistry take examinations in analytical, inorganic, organic, and physical chemistry in order to place students properly in the graduate curriculum. The exams are nationally standardized by the American Chemical Society, and national norms are used. Appropriate course work and didactic opportunities are in place to strengthen any student weakness that may appear from the exams.

Early in the fall semester faculty present a series of short talks that describe their research interests. New graduate students attend these talks and then discuss specific research interests with individual faculty members. After this process, students normally make a decision regarding their research direction and particular advisor around the end of November of the first year. Detailed information about the degree requirements of the program can be found via the Graduate Program link of the Chemistry Department's website.

### DEGREES

- Chemistry AMP (<http://catalogue.uvm.edu/graduate/chemistry/chemistryamp/>)
- Chemistry M.S. (<http://catalogue.uvm.edu/graduate/chemistry/chemistryms/>)
- Chemistry Ph.D. (<http://catalogue.uvm.edu/graduate/chemistry/chemistryphd/>)

### FACULTY

**Brewer, Matthias;** Professor, Department of Chemistry; PHD, University of Wisconsin-Madison

**Hondal, Robert J.;** Associate Professor, Department of Biochemistry; PHD, Ohio State University

**Landry, Christopher C.;** Professor, Department of Chemistry; PHD, Harvard University

**Lee, Andrea J.;** Research Assistant Professor, Department of Microbiology and Molecular Genetics; PHD, University of Wisconsin-Madison

**Li, Jianing;** Associate Professor, Department of Chemistry; PHD, Columbia University

**Liptak, Matthew D.;** Associate Professor, Department of Chemistry; PHD, University of Wisconsin-Madison

**Madalengoitia, Jose S.;** Associate Professor, Department of Chemistry; PHD, University of Virginia

**Mathews, Dwight E.;** Professor Emeritus, Department of Chemistry; PHD, Indiana University Bloomington

**Ou, Yangguang;** Assistant Professor, Department of Chemistry, PHD, University of Pittsburgh

**Petrucci, Giuseppe A.;** Professor, Department of Chemistry; PHD, University of Florida

**Punihaole, David;** Assistant Professor, Department of Chemistry, PHD, University of Pittsburgh

**Ruggiero, Michael T.;** Assistant Professor, Department of Chemistry; PHD, Syracuse University

**Schneebeli, Severin;** Associate Professor, Department of Chemistry; PHD, Columbia University

**Waterman, Rory;** Professor, Department of Chemistry; PHD, University of Chicago

### Courses

#### **CHEM 205. Biochemistry I. 3 Credits.**

Introduction to chemistry and structure of biological macromolecules; examination of mechanisms of chemical processes in biological systems including enzyme catalysis, biosynthesis, regulation, and information transfer. Prerequisite: CHEM 048 or CHEM 142 or CHEM 144. Cross-listed with: BIOC 205 and MMG 205.

#### **CHEM 206. Biochemistry II. 3 Credits.**

Continuation of Biochemistry I. Biochemistry of nucleic acids; nucleic acid based processes, such as replication and transcription; cellular information transfer, genomics, and proteomics. Prerequisite: BIOC 205, CHEM 205, or MMG 205. Cross-listed with: BIOC 206 and MMG 206.

#### **CHEM 207. Biochemistry Lab. 3 Credits.**

Introduction to biochemical tools, including spectrometry, chromatography, and electrophoresis; natural and recombinant enzyme isolation; assays of DNA-modifying enzymes; computer-based structure/function exercises. Prerequisite: BIOC 205, CHEM 205, or MMG 205. Cross-listed with: BIOC 207 and MMG 207.

#### **CHEM 214. Polymer Chemistry. 3 Credits.**

Polymer synthesis and characterization. Kinetic models for polymerization and copolymerization. Physical properties, characterization of polymers in the solid state and in solution. Prerequisite: CHEM 048 or CHEM 142 or CHEM 144, and CHEM 165.

#### **CHEM 221. Instrumental Analysis. 3 Credits.**

Systematic survey of modern methods of chemical analysis. Fundamental principles and applications of spectroscopy, electrochemistry, and separation techniques. Prerequisite: CHEM 121. Credit for or concurrent enrollment in CHEM 165 strongly recommended.

**CHEM 226. Analytical Spectroscopy. 3 Credits.**

Principles of optical spectroscopic methods of analysis. Emphasis on theory and practice of atomic spectroscopy and new molecular spectroscopic methods. Prerequisite: CHEM 221. Alternate years.

**CHEM 231. Advanced Inorganic Chemistry. 3 Credits.**

Molecular symmetry and group theory with an emphasis on applications (vibrational and electronic spectra, bonding and reactivity); introduction to transition metal processes; bioinorganic chemistry. Prerequisite: CHEM 165; CHEM 047, CHEM 141, or CHEM 143.

**CHEM 234. Organometallic Chemistry. 3 Credits.**

Synthesis, structure, bonding, properties, reactions, and applications of organometallic systems; mechanisms of organometallic reactions including oxidative addition and insertion reactions with applications in catalysis. Prerequisite: CHEM 131 or CHEM 231.

**CHEM 236. Physical Inorganic Chemistry. 3 Credits.**

Determination of molecular and electronic structure of inorganic complexes using spectroscopic techniques. Introduction to magnetism. Interpretation of spectroscopic data within the frameworks of group theory and electronic structure calculations. Prerequisites: CHEM 131 and CHEM 165; or CHEM 231.

**CHEM 241. Advanced Organic Chemistry 1. 3 Credits.**

Stereochemistry, conformational analysis, stereoelectronic effects, transition state theory, molecular orbital theory, and reactivity criteria are discussed in regards to reaction mechanisms and functional group manipulations. Prerequisite: CHEM 142 or CHEM 144.

**CHEM 242. Advanced Organic Chemistry 2. 3 Credits.**

Modern synthetic organic methods and approaches to multi-step synthesis are discussed. Selected total syntheses are reviewed to highlight important concepts including diastereoselective and enantioselective processes. Prerequisite: CHEM 241.

**CHEM 260. Advanced Physical Chemistry. 3 Credits.**

Builds on the concepts from Introductory Physical Chemistry (CHEM 165). The three major areas of quantum chemistry, thermodynamics, and kinetics are extended in greater depth, and at a higher level of mathematical rigor. Prerequisite: CHEM 165. Co-requisites: CHEM 167 or MATH 121.

**CHEM 267. Topics in Physical Chemistry. 1-3 Credits.**

Selected topics of current interest in physical chemistry. See Schedule of Courses for specific titles. May be repeated for credit with different content. Topics vary by offering; periodic offering at intervals that may exceed four years. Prerequisite: CHEM 260.

**CHEM 274. Solid State Chemistry. 3 Credits.**

Explores the rich field of solid-state chemistry. Solid-state materials represent some of the most promising advanced materials in development, with applications ranging from pharmaceuticals to flexible electronics. Introduces the chemical physics surrounding solids. Topics include (but are not limited to) crystals and their properties, nanomaterials, semiconductors, and characterization methods. Prerequisite: CHEM 165.

**CHEM 275. Computational Chemistry. 3 Credits.**

Explores the techniques and applications of computational chemistry to model organic, inorganic, and biological molecules. Introduces basic level of classical and quantum modeling, cheminformatics and big chemical data, as well as computer-aided design of new materials and medicines. Prerequisite: CHEM 260.

**CHEM 318. Current Topics in Chemistry. 0 or 1 Credits.**

Survey of current topics in the chemistry literature. May be repeated for credit with different content. Prerequisite: Graduate Chemistry students only.

**CHEM 379. Intro to Graduate Research. 1 Credit.**

Introduction to graduate research in chemistry. Overview of faculty research areas and department/university research resources. Prerequisites: Chemistry graduate students only.

**CHEM 380. Chemical Investigations. 1 Credit.**

Current problems and literature.

**CHEM 381. Grad Seminar. 1 Credit.**

Current problems and literature.

**CHEM 384. Advanced Topics in Chemistry. 2 Credits.**

Comprehensive independent study in chemistry.

**CHEM 390. Internship. 1-18 Credits.**

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

**CHEM 391. Master's Thesis Research. 1-18 Credits.****CHEM 392. Independent Study. 1-18 Credits.**

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

**CHEM 394. Independent Graduate Research. 1-18 Credits.**

Graduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

**CHEM 395. Independent Lit Rsch Project. 1-12 Credits.**

Reading and literature research culminating in the preparation of a comprehensive and critical review of a topic of current interest in chemistry.

**CHEM 396. Advanced Special Topics. 1-18 Credits.**

See Schedule of Courses for specific titles.

**CHEM 484. Advanced Topics in Chemistry. 2 Credits.**

Comprehensive independent study in chemistry.

**CHEM 487. Research Problem Conception. 1 Credit.**

Identification of a current research problem to be addressed by original, independent research. Prerequisite: CHEM 484.

**CHEM 488. Research Problem Solution. 1 Credit.**

Solution to a current research problem to be addressed by original, independent research. Prerequisite: CHEM 487.

**CHEM 490. Internship. 1-18 Credits.**

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

**CHEM 491. Doctoral Dissertation Research. 1-18 Credits.****CHEM 494. Independent Graduate Research. 1-18 Credits.**

Graduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

**CHEM 496. Advanced Special Topics. 1-18 Credits.**

See Schedule of Courses for specific titles.