Chemistry and Physics

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FACULTY

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DEPARTMENT DESCRIPTION

The Department of Chemistry and Physics offers majors in chemistry and physics. The courses of study are designed to meet the highest professional standards and are attuned to meet the needs for students with individual variations in preparation, interests, and career goals. Graduates of the chemistry and physics programs are well prepared to undertake careers in industry or teaching, graduate work in chemistry or physics, or advanced study in professional programs such as law or the health professions (including medicine, pharmacy, or dentistry). The majors in chemistry and physics also allow students to participate in the Five-Year Dual-Degree Engineering Program with the University of Notre Dame.

Some courses in chemistry and physics are offered as a service to the other departments that require backgrounds in chemistry or physics for their students. Other courses are specifically designed to fulfill the Sophia Program requirements in the natural sciences for students who are not science majors but who seek to understand scientific concepts and processes that affect their daily lives in a technology-dependent world.

PROGRAM IN CHEMISTRY

The Bachelor of Science degree in Chemistry has a built-in flexibility that is designed to accommodate the goals of each student while maintaining a rigorous approach to chemistry. All students take a core set of foundational courses, and then choose in-depth courses to meet their educational needs. This includes students who wish to pursue a health profession with a focus in biochemistry. We also have students who pursue the Five-Year Dual-Degree Engineering Program with the University of Notre Dame in chemical or environmental engineering. Students who wish to pursue graduate school in chemistry should consider the American Chemical Society certification (see below). There is the opportunity for students who wish to become high school teachers to satisfy the certification of the National Council for Accreditation of Teacher Education. For those planning on entering careers in the health professions, individual counseling is provided to insure that their programs will provide the depth and breadth that is expected in medical and other professional schools in the health sciences.

ADVANCED WRITING PROFICIENCY

Each student writes a formal paper consisting of a research topic of her choosing. The formal paper is an in-depth presentation of chemistry and reflects a command of the subject appropriate to a senior chemistry major. Students will work closely with a department

faculty member to meet this requirement. It is due by the end of the fall semester of the student's senior year.

SENIOR COMPREHENSIVE

The Senior Comprehensive consists of a poster presentation at the Physical Sciences Poster Session and a 15-minute oral presentation at the Physical Sciences Symposium. The public presentations are on a chemistry topic of the student's choosing and may or may not be related to the research topic of the formal paper. Both presentations are given in the spring semester of the senior year and include a question and answer period. The goal for students is to demonstrate their ability to orally communicate data/results to a scientific audience in formats that they are most likely to experience as professional scientists.

AMERICAN CHEMICAL SOCIETY CERTIFICATION

Saint Mary's College is an American Chemical Society (ACS) approved school in chemistry. For those students interested in a more intensive chemistry program, an ACS-certified curriculum is available. Interested students should contact the department chair for information.

CHEMISTRY PROGRAM LEARNING OUTCOMES

Undergraduate students upon graduation with a B.S. degree in Chemistry:

- Understand and apply the fundamental principles of current chemical theories;
- Think critically to interpret experimental results;
- Demonstrate problem-solving skills, by using systematic reasoning in her approach to problems, and;
- Effectively communicate chemical ideas to different types of audiences (scientific and non-scientific).

Bachelor of Science, Major in Chemistry—CHEM (58 hours)

All of the following:

CHEM 121	Principles of Chemistry I	lab	4 hours
CHEM 122	Principles of Chemistry II	lab	4 hours
CHEM 221	Organic Chemistry I		3 hours
CHEM 221L	Organic Chemistry I Lab	lab	1 hour
CHEM 222	Organic Chemistry II		3 hours
CHEM 222L	Organic Chemistry II Lab	lab	1 hour
CHEM 311	Thermodynamics		3 hours
CHEM 324	Biochemistry		3 hours
CHEM 332	Analytical Chemistry		3 hours
CHEM 342	Bio-Inorganic Chemistry		3 hours
CHEM 361	Advanced Lab I	lab	4 hours
CHEM 362	Advanced Lab II	lab	4 hours

One of the following (not taken above):

CHEM 312	Quantum Chemistry		3 hours
CHEM 342	Bio-Inorganic Chemistry		3 hours
CHEM 424	Advanced Biochemistry		3 hours

Required Supporting Courses

MATH 131	Calculus I (or equivalent)		4 hours
MATH 132	Calculus II (or equivalent)		4 hours
PHYS 121	General Physics I: Mechanics and Waves	lab	4 hours
PHYS 122	General Physics II: Thermodynamics, Electricity and Magnetism, and Optics	lab	4 hours

Minor in Chemistry—CHEM (22–24 hours)

All of the following:

CHEM 121	Principles of Chemistry I	lab	4 hours
CHEM 122	Principles of Chemistry II	lab	4 hours
CHEM 221	Organic Chemistry I		3 hours
CHEM 221L	Organic Chemistry I Lab	lab	1 hour
CHEM 222	Organic Chemistry II		3 hours
CHEM 222L	Organic Chemistry II Lab	lab	1 hour

Two of the following (some courses have prerequisites):

CHEM 311	Thermodynamics		3 hours
CHEM 312	Quantum Chemistry		3 hours
CHEM 324	Biochemistry		3 hours
CHEM 332	Analytical Chemistry		3 hours
CHEM 342	Bio-Inorganic Chemistry		3 hours
CHEM 361	Advanced Lab I	lab	4 hours
CHEM 362	Advanced Lab II	lab	4 hours
CHEM 424	Advanced Biochemistry		3 hours

Certain substitutions may be made with the consent of the department to meet the specialized needs of individual students. Students interested in attending graduate school in chemistry or biochemistry are strongly encouraged to participate in research and should consult the department chair about enrolling in additional chemistry, mathematics, and/or biology courses.

CHEMISTRY COURSES (CHEM)

101 Chemistry for the Citizen (3–4)

A survey course for students majoring in disciplines other than the natural sciences. Application of fundamental chemical principles to selected inorganic, organic, and biological systems, with particular emphasis on topics of interest to citizens in a technological society. Offered in fall or spring semester for 4 credits (Three hours lecture and one two-hour laboratory) or summer session for 3 credits (Three hours lecture, no laboratory).

102 Chemistry in Everyday Life (3)

This course seeks to make the Saint Mary's College student aware of the chemicals that affect her directly as she lives her daily life. (Three lecture hours per week).

118 Integrated General, Organic and Bio-Chemistry (5)

An introduction to the fundamental concepts of general chemistry, organic chemistry and biochemistry with applications to the field of nursing. Laboratory experiments will closely correspond with the lecture material. (Four hours lecture and one two-hour laboratory) Prerequisite: One year high school chemistry and Math 102 or concurrent enrollment in any higher level math course; or permission of the instructor

121 Principles of Chemistry I (4)

This course is an introduction to chemical stoichiometry, atomic and molecular structure, and bonding. Laboratory will explore principles presented in lecture. (Three-hour lecture and one three-hour laboratory). Prerequisite: high school chemistry or permission of the instructor; students must be calculus-ready. For biology, chemistry, physics, and engineering intended majors. This course also satisfies the LO2 Critical Thinking Seminar.

122 Principles of Chemistry II (4)

An introduction to chemical energetics, chemical equilibria, acid-base chemistry, and kinetics. Laboratory will explore principles presented in lecture. (Three hours lecture and one three-hour laboratory) Prerequisite: CHEM 121 or permission of instructor.

221 Organic Chemistry I (3)
A treatment of the properties, structures, preparations and reactions of the important classes of compounds of carbon with emphasis on foundational concepts illustrated primarily through the chemistry of aliphatic hydrocarbons. (Three hours lecture) Prerequisite: CHEM 122.

221L Organic Chemistry Lab I (1)
A course in a variety of organic laboratory skills, including separation and purification techniques. One three hour lab per week. Corequisite: CHEM 221.

222 Organic Chemistry II (3)
A treatment of the properties, structures, preparations and reactions of the important classes of compounds of carbon. Aromatic chemistry is introduced and representative functional groups are covered. Three hours lecture. Prerequisite: CHEM 221 and CHEM 221L.

222L Organic Chemistry Lab II (1)
A course in organic chemistry laboratory skills, including identification using chemical and instrumental methods. One three hour lab per week. Corequisite: CHEM 222.

311 Thermodynamics (3)
A detailed study of thermodynamics, statistical mechanics, and kinetics. This calculus-based course integrates concepts of chemistry and physics. Three hours lecture. Prerequisites: CHEM 122; PHYS 122; Recommended: CHEM 221.

312 Quantum Chemistry (3)
A detailed study of quantum chemistry, including techniques and applications of quantum theory, atomic and molecular structure, bonding, symmetry, group theory, and spectroscopy. (Three hours lecture) Prerequisites: CHEM 122; MATH 231; PHYS 122. Recommended: CHEM 221.

324 Biochemistry (3)
A study of the chemical reactions of cells, the major metabolic pathways, and the interrelationship of these pathways. (Three hours lecture per week) Prerequisites: CHEM 222.

332 Analytical Chemistry (3)
Quantitative methods of analysis are explored. The theory and application of wet chemical techniques and modern instrumental techniques (spectroscopy, chromatography and electrochemistry) are introduced with a focus on method selection and underlying chemical concepts. Analytical chemistry uses of statistics and equilibrium are also discussed. (Three hours lecture per week). Prerequisites: CHEM 221, PHYS 122.

342 Bio-Inorganic Chemistry (3)
This course explores the properties and bonding of inorganic elements that are important to biological systems and biologically-inspired inorganic materials. Students will apply chemical principles in understanding the endogenous roles of metals in charge balance, catalysis, and structure. Students will learn how inorganic chemists design metal-based drugs and imagining agents to solve problems in human health, and how reverse-engineering of bio-inorganic systems have led to revolutionary inorganic solid state- and nano-materials. (Three hours lecture per week) Prerequisite: CHEM 222.

361 Advanced Lab I (4)
Laboratory methods in chemistry are explored. Students will learn how to design and conduct experiments and gain hands-on experience with various laboratory techniques within the overall context of answering chemical questions. They will learn the basic chemical and physical principles upon which these varied techniques are based, plus they will demonstrate and apply their overall chemical knowledge from their first through third years of courses and laboratories. Students will also learn scientific presentation and writing skills. (Two 4-hour laboratories per week). Prerequisite: CHEM 222.

362 Advanced Lab II (4)
A continuation of Chemistry 361, students will explore more advanced laboratory techniques, building upon their experience of the previous course. Students will also build their scientific writing and presentation skills. (Two 4-hour laboratories per week). Prerequisite: CHEM 361.

424 Advanced Biochemistry (3)
Advanced topics in the chemistry and chemical mechanisms involved in intermediary metabolism and developmental processes with consideration of the biochemistry current in the literature. Offered according to student demand. (Three hours lecture per week). Prerequisites: CHEM 324 and 311, or permission of instructor.

431 Advanced Inorganic Chemistry (3)
A study of modern inorganic chemistry with emphasis on the principles, properties, and chemical trends of coordination compounds, This course will also explore the essentials of structure, bonding, symmetry, spectroscopy, and reactivity. (Three hours lecture per week). Prerequisite: CHEM 342. Concurrent or Prerequisite: CHEM 312.

485 Research (1–3)
Participation in original experimental or theoretical investigation in collaboration with a member of the faculty. Prerequisite: Permission of the department chair. May be repeated.

490 Topics in Chemistry (2–3)
Topics in Chemistry not covered in the regular department offerings and selected according to the interests of the students and instructor. Offered according to student demand. (Two or three lectures per week) Prerequisite: Permission of the instructor. May be repeated for credit with a different topic.

497 Independent Study (1–2)
Enables properly qualified students to carry out independent study under the guidance of an instructor. Content dependent on student need and interest. Elective with permission of the department chair. Generally graded S/U; may be letter graded. May be repeated with a different topic.

499 Chemistry Internship (1–4)
Graded S/U.