CHEMISTRY / BIOCHEMISTRY

The Department of Chemistry is known nationally for its excellent program. In a study of chemistry programs at private four-year colleges published in the *Journal of Chemical Education*, the Hope College Department of Chemistry was recognized as outstanding in the productivity of its research program and for the accomplishments of its graduates. The chemistry program is approved by the American Chemical Society's Committee on Professional Training.

ABOUT THE PROGRAM

The program provides students with a rigorous introduction to the fields of chemistry and biochemistry in a setting that emphasizes knowledge of current developments in chemistry and experience with modern instruments and laboratory techniques. The chemistry faculty maintains a keen interest in students' professional involvement and scholarly development. The department has an active seminar program which brings students into contact with nationally recognized authorities in chemistry and chemistry-related fields.

The chemistry program places a strong emphasis on faculty-student research. Chemistry majors are encouraged to begin work with a professor on a research project early in their academic program. Research stipends are available to enable many students to work full-time on their projects during the summer. Student research is directed toward professional development and may result in joint authorship of scientific publications and in the opportunity to present research results at a regional or national scientific meeting.

MAJORS

The chemistry major includes sequences of both lecture and laboratory courses designed to establish a fundamental understanding of the major areas of the discipline. Students can elect to complete a chemistry major for a B.A. degree or a more extensive major for a B.S. degree. Students planning to do graduate work in the field or to enter industry should fulfill the requirements of the American Chemical Society's (ACS) Certified Major Program. An ACS-certified B.S. Degree Program in Chemistry with Biochemistry Emphasis is available for students who have interests in chemistry and biology. A B.S. degree in Biochemistry and Molecular Biology is offered jointly by the departments of Chemistry and Biology, and is available for those students who seek a degree at the interface of these two disciplines. A complete description of the Biochemistry and Molecular Biology B.S. degree requirements can be seen here. Students who intend to enter medical or dental schools or plan a career in secondary education may design their major program according to their specific goals. Since students planning a chemistry major have a number of options, it is essential that they discuss their plans with the chairperson of the department or a chemistry advisor early in their academic program.

ACS Certified Bachelor of Science Degree in Chemistry

Hope College is approved by the American Chemical Society to offer an ACS-Certified B.S. degree in chemistry if the following requirements are met in addition to the 32 credits of chemistry listed in the B.S. degree requirements:

- CHEM 311 – Biochemistry I
- CHEM 324 – Inorganic Lab

A student must also take at least two other advanced lecture courses. At least one must be from:

- CHEM 314 – Biochemistry II
- CHEM 421 – Structure, Dynamics, Synth I
- CHEM 422 – Structure, Dynamics, Synth II

The second can be from the previous courses or from:

- CHEM 335 – Neurochemistry
- GES 430 – Adv. Environmental Geochemistry

In addition to the lecture courses, an ACS-certified major requires that a student have 400 contact hours of laboratory experience beyond General Chemistry. Laboratory coursework must include analytical, inorganic, organic and physical chemistry lab. Research experience may count for up to 84 hours if a student prepares a well-written, comprehensive and well-documented research report.

ACS Certified Bachelor of Science Degree in Chemistry with Biochemistry Emphasis

Hope College also offers an ACS-certified B.S. degree with biochemistry option if the following requirements are met in addition to the regular BS degree requirements listed above (with the exception that Physical Chemistry II lecture and lab are not required):

- CHEM 311 – Biochemistry I
- CHEM 314 – Biochemistry II
- CHEM 315 – Biochemistry Lab

Three credits of advanced biology, from among BIOL 335 (Neurochem), BIOL 348 (Cell Biology), BIOL 356 (Genetics) or BIOL 366 (Molecular Biology); these advanced biology courses have a prerequisite of the core courses in biology.

A student must also take at least one additional advanced lecture courses from the list below (CHEM 335 can only be counted once, either for advanced biology or for advanced chemistry).

- CHEM 335 – Neurochemistry
- CHEM 344 – Physical Chemistry II
- CHEM 421 – Structure, Dynamics, Synth I
- CHEM 422 – Structure, Dynamics, Synth II

In addition to the lecture courses, an ACS-certified major requires that a student have 400 contact hours of laboratory experience beyond General Chemistry. Laboratory coursework must include analytical, biochemistry, organic and physical chemistry lab. Research experience may count for up to 84 hours if a student prepares a well-written, comprehensive and well-documented research report.

BACHELOR OF SCIENCE DEGREE IN BIOCHEMISTRY AND MOLECULAR BIOLOGY

The B.S. degree in biochemistry and molecular biology requires completion of selected chemistry and biology courses. The details of this degree can be found here.

Courses 101, 103 and 104 are designed primarily for students not majoring in one of the sciences.

Chemistry

BACHELOR OF ARTS DEGREE

The minimum requirements for a chemistry major are twenty-five (25) credits of science major chemistry courses, two semesters of physics with laboratory and Calculus I (MATH 131, or MATH 125 and MATH 126) and II (MATH 132).

While calculus-based General Physics 121, 141, 122 and 142 are recommended for the B.A. degree and are required for the B.S. degree, students seeking the B.A. degree may wish to consult their academic advisor to discuss if College Physics 105, 106, 107 and 108 are appropriate for their program of study.

The chemistry courses must include: CHEM 125, 126 (or 131), 221, 231; six credits of laboratory courses (e.g., CHEM 127, 128 (or 132), 255 and 256A and 256B; CHEM 315, 324, 332, 335, 345 or other laboratory courses may be included in these 6 credits; and two courses selected from CHEM 311, 322, 331 and 332 or 343. (CHEM 331 and 332 must be taken together and are considered one course.) A minimum GPA of 2.0 is required for the science-major chemistry courses.

BACHELOR OF SCIENCE DEGREE

The B.S. degree in chemistry requires 36 credits of science major chemistry courses and a total of 60 credits in the natural sciences. A minimum GPA of 2.0 is required for all science- major chemistry courses in the degree. The B.S. degree must include the 32 credits of chemistry, 8 credits of physics and 8 credits of mathematics that are listed below.

- CHEM 125 – General Chem I, 3 credits
- CHEM 127 – Gen Chem Lab I, 1 credit
- CHEM 126 – General Chem II, 3 credits
- CHEM 128 – Gen Chem Lab II , 1 credit
- CHEM 221 – Organic Chem I , 3 credits
- CHEM 255 – Org Chem Lab I, 2 credits
- CHEM 231 – Organic Chem II, 3 credits
- CHEM 256A – Org Chem Lab II, 1 credit
- CHEM 322 – Inorganic Chem, 3 credits
- CHEM 331 – Analytical Chem, 3 credits
- CHEM 332 – Analytical Chem Lab, 1 credit
- CHEM 343 – Physical Chem I, 3 credits
- CHEM 345 – Phys Chem Lab I, 1 credit
- CHEM 344 – Physical Chem II, 3 credits
- CHEM 346 – Phys Chem Lab II, 1 credit
- PHYS 121 – Gen Phys I
- PHYS 141 – Phys Lab I
- PHYS 122 – Gen Phys II
- PHYS 142 – Phys Lab II
- MATH 131 – Calc I (or Math 125 and Math 126)
- MATH 132 – Calc II

Strongly Recommended Courses:

MATH 231 – Multivariable Math I

MATH 232 – Multivariable Math II

Alternatively, CHEM 131 and 132, Accelerated General Chemistry and Accelerated General Chemistry Laboratory, may be substituted for the two-semester general chemistry sequence of CHEM 125 and 127, plus CHEM 126 and 128. Since the material covered in this accelerated one-semester general chemistry course is the same as the material covered in the two-semester sequence, credit for CHEM125 and 127 will be awarded upon successful completion of CHEM 131 and 132.

In addition to the courses listed above, a student must complete four other credits of 200-, 300- or 400- level lecture or laboratory courses for a total of 36 credits. Suggested courses are listed below:

- CHEM 256B – Organic Chemistry Lab II, 1 credit

- CHEM 347 – Chemical Modeling Lab, 1 credit
- CHEM 311 – Biochemistry I, 3 credits
- CHEM 348 – Advanced Spectroscopy Lab, 1 credit
- CHEM 314 – Biochemistry II, 3 credits
- CHEM 421 – Struct. Dynam. & Syn. I, 3 credits
- CHEM 315 – Biochem Lab, 1 credits
- CHEM 422 – Struct. Dynam. & Syn. II, 3 credits
- CHEM 324 – Inorganic Lab, 1 credit
- CHEM 490 – Research, 1-2 credits
- CHEM 335 – Neurochemistry, 4 credits

For students planning to go to graduate school in chemistry, it is essential to take MATH 231 and 232. Depending on the student's background in mathematics, General Physics 121 may be taken in the freshman year or taken no later than the second semester of the sophomore year. College Physics 105, 106, 107, and 108 do not satisfy requirements for the B.S. degree.

Pre-medical, pre-dental and pre-veterinary students are advised to take the following courses in chemistry: 125, 127, 126, 128 (or 131, 132), 221, 231, 255, 256A, 311, 314 and 315. These students should consult with the Health Professions Advisor as early as possible to insure that their chemistry major meets the specific requirement of their intended profession. Suggested courses to prepare for medical school are in the Pre-Professional Programs section.

Students interested in chemical engineering should consult with the chairperson of the Chemistry Department and an engineering advisor early in their undergraduate program.

Students who are interested in combined science fields, special programs or contract curriculums should consult with the appropriate chairpersons as early as possible to learn of opportunities, prospects and requirements.

Chemistry Education

In partnership with the Hope College Department of Education, the Department of Chemistry offers a teaching major for certification through the State of Michigan. This includes a 30-credit major.

The chemistry major must consist of all the courses required for the B.A. degree (including the mathematics and physics courses) and additional upper-level courses to meet the 30-credit requirement.

All education students must take a methods course in their major and minor areas of study.

MINORS

Biochemistry

The requirement for a biochemistry minor is 22 credits of chemistry courses including: CHEM 125, 127, 126, 128 (or 131, 132), 221, 231, 255, 311 and 314.

Note: The biochemistry minor is not awarded in conjunction with either the B.A. or the B.S. major in chemistry. In addition, a biochemistry minor is not awarded with a chemistry minor.

Chemistry

The requirement for a chemistry minor is 21 credits of chemistry courses including: CHEM 125, 127, 126, 128 (or 131, 132), 221, 255 and eight additional credits of science major chemistry courses.

Chemistry Education

In partnership with the Hope College Department of Education, the Department of Chemistry offers a teaching minor for certification through the State of Michigan. This includes a 21-credit minor in chemistry.

All education students must take a methods course in their major and minor areas of study.

COURSES

CHEMISTRY

CHEM 101 - Introduction to Chemistry

This course presents selected chemical concepts at an introductory level for students who are not majoring in one of the sciences. Topics include atomic, ionic and molecular properties, bonding, balanced equations, acids and bases, solutions, simple organic structures, polymers, and nuclear chemistry. Laboratory activities support concepts presented in lecture. Lecture, 3 hours per week; laboratory, one 3-hour session per week. Gems 100, Math 205, or any calculus or statistics course is highly recommended prior to enrollment in or concurrently with this course. Cross-listed as Gems 160.

Credits Awarded: 4
Terms Offered: Spring
Attribute: Natural Science I with lab (NSL)

CHEM 103 - Introduction to Biological Chemistry

This course will equip students with analytic and conceptual skills in general, organic, and biological chemistry as they relate to human health and health care. It is particularly focused on the basic chemistry needed by students seeking to enter professional programs in nursing and in a few allied health fields. This course is also suitable for the non-science major student as partial fulfillment of the mathematics and natural science general education requirement. This course does not count toward a major in biochemistry/molecular biology, biology, or chemistry. Lecture, 3 hours per week; laboratory, one 3-hour session per week. CHEM 101 or GEMS 160 or one year of high school chemistry, with lab, is highly recommended prior to this course.

Credits Awarded: 4
Terms Offered: Spring
Attribute: Natural Science I with lab (NSL)

CHEM 104 - Matter and Energy

Matter and Energy is one of a two-semester sequence of courses. The combined courses ("Matter and Energy" and "Organisms and Environments") will satisfy the natural science laboratory general education requirements only for elementary education teacher candidates. The courses will also cover the content that is important for the future educators in an integrated inquiry-based format. The content in this recommended course sequence will flow from the physical science to earth/space science to life science topics that students will find themselves teaching in the future. This course will primarily include content from physical science and earth/space science, though due to the interdisciplinary nature of many of the topics, life science will also be addressed where appropriate. CHEM 104 is intended for students seeking teacher certification. These students will have enrollment priority for this class.

Credits Awarded: 4
Terms Offered: Fall, Spring
Attribute: Natural Science I with lab (NSL)

CHEM 125 - General Chemistry I

This is the first course in a two-semester sequence of introductory chemistry that is for all students who wish to major in science and who do not have a thorough high-school preparation in chemistry. The material is supplemented by reviewing high school chemistry as needed, and topics are taught at a slower pace than in Chem 131. Topics include stoichiometry, states of matter, atomic structure, periodicity, chemical bonding, and geometry of molecules. Lecture, 3 hours per week; discussion, 1 hour per week.

Credits Awarded: 3
Terms Offered: Fall
Corequisites: Chem 127
Attribute: Natural Science I with lab (NSL)

CHEM 126 - General Chemistry II

This is the second in a two-semester sequence of introductory chemistry that is for all students who wish to major in science and who do not have a thorough high-school preparation in chemistry. Topics include chemical energy, equilibria, kinetics, acids and bases, and chemical reaction types. Lecture, 3 hours per week; discussion session, 1 hour per week.

Credits Awarded: 3
Terms Offered: Spring
Prerequisites: Chem 125 with a grade of C- or better
Corequisites: Chem 128
Attribute: Natural Science I with lab (NSL)

CHEM 127 - General Chemistry Laboratory I

This course provides an introduction to chemical techniques and laboratory procedures. Topics include qualitative analysis, gas laws, colorimetry, spectroscopy, colligative properties, computational modeling and computerized data collection and analysis. Laboratory, one 3-hour session per week (42 lab hours).

Credit Awarded: 1
Terms Offered: Fall
Corequisites: Chem 125
Attribute: Natural Science I with lab (NSL)

CHEM 128 - General Chemistry Laboratory II

This is a continuation of Chem 127. Topics include calorimetry, volumetric and potentiometric titrations, reaction kinetics, determination of acid dissociation constants, and computerized data collection and analysis. Laboratory, one 3-hour session per week (42 lab hours).

Credit Awarded: 1
Terms Offered: Spring
Corequisites: Chem 126
Attribute: Natural Science I with lab (NSL)

CHEM 131 - Accelerated General Chemistry

This one-semester course covers all the general chemistry material normally covered in Chem 125 and 126. This will include stoichiometry and inorganic reactions, periodicity and atomic structure, chemical bonding and molecular structure, chemical energy and thermodynamics, reaction kinetics, acids and bases and ionic equilibria. This course is designed for entering students that have a strong high-school chemistry background and good algebra skills. Upon successful completion of this course, credit will be awarded for Chem 125 as well. Lecture, 3 hours per week; discussion session, 1 hour per week. Two years of high school chemistry and ACT math score of 30+ (or SAT math score 670+) highly recommended.

Credits Awarded: 3
Terms Offered: Fall
Corequisites: Chem 132
Attribute: Natural Science I with lab (NSL)

CHEM 132 - Accelerated General Chemistry Lab

This one-semester course covers all the general chemistry material normally covered in Chem 127 and 128. This will include qualitative analysis, colorimetry and spectroscopy, colligative properties, titration, calorimetry, spectrophotometric determination of reaction kinetics, atomic absorption, and computerized data collection and analysis. This course is designed for entering students that have a strong high-school chemistry background and good algebra skills. Upon successful completion of this course, credit will be awarded for Chem 127 as well. Laboratory, one 3-hour session per week (42 lab hours).

Credit Awarded: 1
Terms Offered: Fall
Corequisites: Chem 131
Attribute: Natural Science I with lab (NSL)

CHEM 195 - Studies in Chemistry

A course offered in response to student and instructor interest. Topics are not generally covered in the regular course listings. Course may be taken multiple times if topics are different.

Credits Awarded: 1-3
Terms Offered: As Needed
Prerequisites: Permission of instructor

CHEM 221 - Organic Chemistry I

The basic principles of organic chemistry are introduced through studies of the structures and reactions of carbon compounds. The mechanistic treatment of aliphatic and aromatic chemistry is stressed. Lecture, 3 hours per week; discussion session, 1 hour per week.

Credits Awarded: 3
Terms Offered: Fall
Prerequisites: Chem 126 or Chem 131 with a grade of C- or better

CHEM 231 - Organic Chemistry II

This is a continuation of Chem 221 with emphasis on complex molecules, including those found in biological systems. Lecture, 3 hours per week; discussion session, 1 hour per week.

Credits Awarded: 3
Terms Offered: Spring
Prerequisites: Chem 221 with a grade of C- or better

CHEM 255 - Organic Chemistry Laboratory I

This laboratory course stresses modern techniques for analyses of organic compounds and studies of the mechanisms of organic reactions. Infrared spectral analyses and chromatographic separations are introduced. Laboratory, one 5-hour session per week; discussion session, 1 hour per week (84 lab hours). Students may take Chem 221 either prior to enrollment in or concurrently with the course.

Credits Awarded: 2
Terms Offered: Fall
Prerequisites: Chem 126 or Chem 131 with a grade of C- or better, Chem 221
Corequisites: Chem 221

CHEM 256 - Organic Chemistry Laboratory II

Chem 256A, Organic Chemistry Laboratory II:

This is a continuation of Chem 255 with emphasis on organic structure determination and organic synthesis. Nuclear magnetic resonance spectroscopy and mass spectrometry are introduced. Laboratory, one 5-hour session per week; discussion session, 1 hour per week. The 7 weeks of this laboratory (42 lab hours) comprise the 1 credit that is required for a chemistry major. Offered first half of the semester. Students may take Chem 231 either prior to enrollment in or concurrently with the class.

Chem 256B, Organic Chemistry Laboratory Independent Project:

This 7-week (42 lab hours) section is an optional continuation of Chem 256A to be taken in the same semester. In Chem 256B, students will search the chemical literature, write a proposal, and execute an independent synthetic project. Students will grow in independence and autonomy and gain appreciation for authentic research while developing new skills such as reaction design, spectroscopic analysis, and the purification and characterization of mixtures. Offered last half of the semester. Students may take Chem 231 either prior to enrollment in or concurrently with the class.

Credit Awarded: 1
Terms Offered: Spring
Prerequisites: Chem 221 and Chem 255, Chem 231
Corequisites: Chem 231

CHEM 295 - Studies in Chemistry

A lecture and/or laboratory course in a chemical area of current interest.

Credits Awarded: 1-3
Terms Offered: As Needed
Prerequisites: Permission of instructor

CHEM 311 - Biochemistry I

The biochemistry of proteins, carbohydrates, lipids, enzymes and coenzymes is discussed with an emphasis on the structure/function properties of biomolecules. Biol 106 or equivalent is highly recommended prior to this course. Lecture, 3 hours per week; discussion session, 1 hour per week.

Credits Awarded: 3
Terms Offered: Fall
Prerequisites: Chem 231 with a grade of C- or better

CHEM 314 - Biochemistry II

The course is a continuation of Chem 311 with emphasis on metabolic pathways (lipids, carbohydrates and proteins), regulatory processes, and transfer of genetic information. Lecture, 3 hours per week; discussion session, 1 hour per week.

Credits Awarded: 3
Terms Offered: Spring
Prerequisites: Chem 311 with a grade of C- or better

CHEM 315 - Biochemistry Laboratory

The laboratory course introduces general protein biochemistry experiments including protein purification, enzyme kinetics, fluorescence, chromatography, electrophoresis and spectrophotometry. Laboratory, one 5-hour session per week; discussion session, 1 hour per week (42 lab hours).

Credit Awarded: 1
Terms Offered: Spring
Prerequisites: Chem 311 with a grade of C- or better

CHEM 322 - Inorganic Chemistry

A detailed examination of covalent and ionic inorganic substances, Lewis acid-base concepts, thermodynamic aspects, coordination chemistry, chemistry of metals and nonmetals, inorganic aspects of aqueous and nonaqueous solvents. Lecture, 3 hours per week.

Credits Awarded: 3
Terms Offered: Spring
Prerequisites: Chem 221

CHEM 324 - Inorganic Chemistry Laboratory

Laboratory experiments provide an introduction to modern laboratory techniques used in inorganic chemistry. The work stresses synthetic techniques (including the handling of air-sensitive materials in glove boxes and on vacuum lines), the preparation of novel materials of an inorganic and bioinorganic nature, and the study of their chemical, physical, structural, and kinetic properties by modern instrumental techniques. Laboratory, one 3-hour session per week (42 lab hours). Students may take Chem 322 either prior to enrollment or concurrently with the class.

Credit Awarded: 1
Terms Offered: Spring
Prerequisites: Chem 256, Chem 322
Corequisites: Chem 322

CHEM 326 - Communication in Chemistry and Biochemistry

This course builds upon communication practices in chemistry and biochemistry that have been previously introduced. Skills such as searching the literature, using citation managers, reading primary literature, writing science effectively for different audiences preparing proposals and manuscripts, and presenting orally will be developed. This course is designed for both research active and research non-active students, and students can focus their classwork on individual communication goals including preparation of a research proposal, a literature review, a manuscript, or an American Chemical Society research report or general workplace communication skills. Differentiated instruction will be used to meet each student's communication goals.

Credits Awarded: 2
Terms Offered: Spring, first-half
Prerequisites: Chem 221

CHEM 331 - Analytical Chemistry Lecture

Lecture topics include statistics, sampling, chemical equilibrium, titrimetric procedures, spectroscopy, separations and electrochemistry as well as an introduction to modern analytical instrumentation. Lecture, 3 hours per week; discussion session, 1 hour per week.

Credits Awarded: 3
Terms Offered: Fall, Spring
Prerequisites: Chem 126 and Chem 128, or Chem 131 and Chem 132
Corequisites: Chem 332

CHEM 332 - Analytical Chemistry Laboratory

Laboratory experiments apply the total analytical process to real samples, including sample collection, chemical workup, wet chemical and instrumental analysis. Methods of analysis include standard volumetric procedures, UV/VIS spectroscopy, atomic absorption, ion selective electrodes, gas chromatography-mass spectrometry, and HPLC, as well as standard methods from various official agencies. Extensive data analysis using spreadsheets. Laboratory, one 3-hour session per week (42 lab hours).

Credit Awarded: 1
Terms Offered: Fall, Spring
Corequisites: Chem 331

CHEM 335 - Neurochemistry and Disease

The biochemistry of the brain and how it influences nervous system function, specifically of motor and cognitive processes, will be studied. The relationship between altered neurochemical activity and disease states will be explored using a case study approach. The laboratory component will introduce several neurochemistry techniques and a novel neurochemistry research project. Lecture, 3 hours per week; laboratory, one 3-hour session per week. Cross-listed with Biol 335 and Nsci 335.

Credits Awarded: 4
Terms Offered: Spring, Even Years
Prerequisites: Biol 105 and Biol 106, Biol 107 or equivalent, Biol 108 or equivalent, Or, Chem 311 or NSCI 211
Attribute: Natural Science I with lab (NSL)

CHEM 343 - Physical Chemistry I

The basic principles of physical chemistry are introduced with applications in the chemical and biological sciences. Underlying principles of thermodynamics, equilibrium, and kinetics are developed and applied to solutions, enzymes, spectroscopy, and macromolecules from macroscopic and statistical perspectives. Lecture, 3 hours per week; discussion session, 1 hour per week. Students may take Phys 121 or Engs 340 either prior to enrollment in or concurrently with the class. Math 231 is highly recommended prior to this course.

Credits Awarded: 3
Terms Offered: Fall
Prerequisites: Chem 126 or Chem 131, Math 132, Phys 121 or Engs 340
Corequisites: Phys 121 or Engs 340

CHEM 344 - Physical Chemistry II

The quantum description of matter is investigated by studying basic concepts of quantum mechanics, simple quantum models, atomic orbitals, molecular energy levels, spectroscopy, and chemical bonding. Lecture, 3 hours per week; discussion session, 1 hour per week. Students may take Phys 122 either prior to enrollment in or concurrently with the class. Math 231 and Math 232 are highly recommended prior to this course.

Credits Awarded: 3
Terms Offered: Spring
Prerequisites: Chem 126 or Chem 131, Math 132, Phys 122
Corequisites: Phys 122

CHEM 345 - Physical Chemistry Laboratory I

Laboratory experiments provide an introduction to modern laboratory techniques used in physical chemistry. The work stresses thermochemistry, kinetics, transport phenomena, data and error analysis, vacuum techniques, the use of instrumentation, and technical report writing in obtaining, analyzing and presenting accurate data from chemical systems. Laboratory, one 3-hour session per week (42 lab hours). Students may take Chem 343 either prior to enrollment in or concurrently with the class.

Credit Awarded: 1
Terms Offered: Fall
Prerequisites: Chem 343
Corequisites: Chem 343

CHEM 346 - Physical Chemistry Laboratory II

Molecular structure and dynamics of chemical systems are studied using Fourier transform infrared and ultra-violet spectroscopy. Spectral interpretation in terms of basic quantum mechanical models is emphasized. Laboratory, one 3-hour session per week (42 lab hours). Students may take Chem 344 either prior to enrollment in or concurrently with the class.

Credit Awarded: 1
Terms Offered: Spring
Prerequisites: Chem 344
Corequisites: Chem 344

CHEM 350 - Advanced Laboratory Techniques

This course builds upon prior knowledge and skills in other core laboratory courses to utilize existing instrumentation or techniques in analysis and identification of chemical species and processes. In addition to in depth study of one or more of these techniques, course work will also include the reading of primary literature and laboratory work. Specific titles may include:

Separations - This course will focus on advanced analytical separation techniques. The theory of separations, alongside practical instrumentation (including gas and liquid chromatography) and experimental design.

Advanced NMR - Modern nuclear magnetic resonance (NMR) techniques will be studied in both theory and practical use. This will include multi-dimensional proton NMR, as well as heteroatom (such as carbon-13, fluorine-19, and/or other nuclei) spectroscopic methods.

Credits Awarded: 2
Terms Offered: Spring, first-half, every two years
Prerequisites: Chem 221 and Chem 255, Or Chem 331 and Chem 332

CHEM 352 - Reactions, Mechanisms, and Synthesis

This course builds upon prior knowledge to critically explore areas within reaction mechanisms, modern reaction development, and/or chemical synthesis. In addition to in depth study of one or more of these areas, course work will also include the reading of primary literature and scientific writing. Specific titles may include:

Organic Reaction Mechanisms - This course will focus on the understanding and prediction of reaction mechanisms for organic transformations.

Organometallics - This course will focus on the understanding and fundamental organometallic transformations, aspects of their relativity, and their use in catalytic cycles.

Credits Awarded: 2
Terms Offered: Spring, first-half, every two years
Prerequisites: Chem 231

CHEM 354 - Computational Chemistry

These courses develop students' skills and knowledge in using computational methods to solve chemical problems. Course work emphasizes hands-on learning and authentic research projects. Specific titles may include:

Computational Chemistry - This course will focus on using various computational engines to study chemical structure, molecular orbitals, spectroscopic behavior, and transition states.

Coding for Scientists - Students will learn the basics of coding such as data types, conditionals, functions, and arguments. They will apply their skills to address a current research problem in chemistry or a related discipline. Coding for Scientists must be taken concurrently with CSCI 195, Intro to Programming with Python.

Credits Awarded: 2
Terms Offered: Spring, last-half, every two years
Prerequisites: Chem 221

CHEM 356 - Structures and Materials

This course builds upon prior knowledge to critically explore areas critical to molecular structure, including chemical bonding and molecular orbital theory. In addition to the in-depth study of one or more of these areas, course work will include the reading of primary literature and scientific writing. Specific titles may include:

Statistical Mechanics - This course will focus on the probabilistic approach to equilibrium properties of chemical systems. The definition of macrostates as deriving from ensembles or microstates and the way these lead to mathematical models.

Group Theory - This course will focus on the use of group theory, including point groups, characters and representations, to understand and predict molecular bonding and spectroscopic properties.

Credits Awarded: 2
Terms Offered: Spring, first-half, every two years
Prerequisites: Chem 231

CHEM 395 - Special Topics in Chemistry

This course may be a lecture or laboratory on a topic in chemistry related to special interests of the faculty or to significant current developments in the field. The content of this course will build in a significant way on concepts introduced in the core courses required for the B.S. degree.

Credits Awarded: 1-3
Terms Offered: As Needed
Prerequisites: Permission of instructor

CHEM 490 - Research in Chemistry

This course provides chemistry majors an opportunity to do research in a field in which students and faculty have special interests. An appropriate report must be submitted to the department chairperson in order for credit to be awarded. Students should contact faculty or the department chairperson to arrange for research with a faculty member (84 lab hours).

Credits Awarded: 0-3
Terms Offered: Fall, Spring
Prerequisites: Permission of instructor

CHEM 499 - Internship in Chemistry

This program provides chemistry training and skill development for the student. This is usually done off-campus and the student must work under the supervision of a qualified scientist. Written reports appropriate to the internship experience are required. Consultation with chemistry faculty internship supervisor about the internship process and completion of the "Permission to Register for An Academic Internship" form and/or the "Academic Internship Registration" form (available at www.hope.edu/academic/intern/Contacts.htm) are required.

Credits Awarded: 1-2
Terms Offered: Fall, Spring
Prerequisites: Permission of instructor

FACULTY & STAFF

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B.S., Calvin University, 1986

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The Edward & Elizabeth Hofma Professor of Chemistry (1988)
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