

CHEMISTRY AND BIOCHEMISTRY (Updated 7.20.22)

The Chemistry and Biochemistry Program at HSU has been approved by the American Chemical Society's Committee on Professional Training. This approval is an honor felt by and a testament to the exceptional education that our students receive. Students who take the required courses will receive recognition and a certificate indicating that they have received an ACS certified B.S. degree in chemistry.

During the semester of expected graduation, all majors will be expected to complete the American Chemical Society's Diagnostic of Undergraduate Chemistry Knowledge exam. While the student's performance on this exam will neither assure nor deny graduation, it is a useful individual diagnostic tool, necessary for program assessment.

The objectives of the Chemistry and Biochemistry programs are as follows: to prepare students for careers and graduate study in chemistry; and to provide pre-professional training in the fields of medicine, dentistry, optometry, pharmacy, nursing, medical laboratory sciences, and other allied health fields.

BS Degree in Chemistry - Requirements Hours

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|--|----|
| CHM 1014, 1024 University Chemistry I and II..... | 8 |
| CHM 2084 Quantitative Analysis | 4 |
| CHM 3063, 3073 Organic Chemistry I and II..... | 6 |
| CHM 3051, 3131 Organic Chemistry Lab I and II..... | 2 |
| CHM 3413 Introduction to Research..... | 3 |
| CHM 3424 Inorganic Chemistry | 4 |
| CHM 4113, 4143 Physical Chemistry I and II | 6 |
| CHM 4091, 4101 Physical Chemistry I and II Laboratory..... | 2 |
| CHM 4181 Independent Research (required twice) | 2 |
| CHM 4154 Instrumental Analysis..... | 4 |
| <i>Total Chemistry Hours</i> | 41 |

Non-chemistry requirements:

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|---|----|
| MTH 1294, 2044 Calculus I & II..... | 8 |
| PHY 2234, 2244 University Physics I & II..... | 8 |
| <i>Non-Chemistry Hours</i> | 16 |
| <i>Total Hours</i> | 57 |

ACS Certification Requirements: BS Chemistry

Courses listed above plus:

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|---------------------------------|---|
| CHM 4283 Biochemistry I..... | 3 |
| CHM 4381 Biochemistry Lab | 1 |

One upper-level chemistry elective from the following choices:

CHM 3193 Environmental Chemistry, CHM 4274 Organic Analysis, CHM 4393 Biochemistry II, CHM 4173 Medicinal Chemistry, CHM 4343 Advanced Organic Chemistry, or CHM 4353 Special Topics in Chemistry.

One 3000/4000 level math course beyond Calculus II.

BS Degree in Chemistry - Biochemistry Track - Requirements Hours

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|--|-----------|
| CHM 1014, 1024 University Chemistry I and II | 8 |
| CHM 2084 Quantitative Analysis | 4 |
| CHM 3063, 3073 Organic Chemistry I and II..... | 6 |
| CHM 3051, 3131 Organic Chemistry Lab I and II..... | 2 |
| CHM 3403 Physical Chemistry for Life Sciences..... | 3 |
| CHM 3413 Introduction to Research | 3 |
| CHM 3424 Inorganic Chemistry..... | 4 |
| CHM 4283, 4393 Biochemistry I and II..... | 6 |
| CHM 4381 Biochemistry lab | 1 |
| CHM 4181 Independent Research (required twice) | 2 |
| <i>Total Chemistry Hours.....</i> | <i>39</i> |

Non-chemistry requirements:

| | |
|--|-----------|
| BIO 2114 Zoology | 4 |
| BIO 3054 Genetics..... | 4 |
| BIO 3094 Microbiology | 4 |
| BIO 4124 Cell Biology | 4 |
| MTH 1294 Calculus I | 4 |
| PHY 2234, 2244 University Physics I & II and labs..... | 8 |
| <i>Total Non-Chemistry Hours.....</i> | <i>28</i> |

Required electives: Three of the following – One must be a chemistry course. Other course options are possible with the consent of the program. All requests must go through the Chemistry chair.

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|---|---|
| CHM 4154 Instrumental Analysis..... | 4 |
| CHM 4274 Organic Analysis..... | 4 |
| BIO 3544/3554 Human Anatomy & Physiology I & II | 8 |
| BIO 4563 Biology of Cancer | 3 |

| | |
|---------------------------------------|----------|
| CHM 4173 Medicinal Chemistry | 3 |
| CHM 3193 Environmental Chemistry..... | 3 |
| BIO 3314 Animal Physiology..... | 3 |
| <i>Elective Hours</i> | 9 to 16 |
| <i>Total Hours</i> | 76 to 83 |

ACS Certification Requirements: BS Biochemistry

Courses listed above plus:

CHM 4113 Physical Chemistry I (in place of CHM 3403 Physical Chemistry for Life) CHM
4091 Physical Chemistry I Lab
MTH 2044 Calculus II

Two other upper-level Chemistry electives from the following choices:

CHM 4154 Instrumental Analysis, CHM 3193 Environmental Chemistry, CHM 4274 Organic Analysis, CHM
4173 Medicinal Chemistry, CHM 4143/4101 Physical Chemistry II & lab, CHM 4343 Advanced Organic
Chemistry, and CHM 4353 Special Topics in Chemistry.

Other Requirements of Note

1. A math ACT score of 22 or greater is required for any freshman to enroll in University Chemistry I (CHM 1014).
2. A grade of "C" or better is required in all prerequisites for any chemistry course.
3. A grade of "C" or better is mandatory in every course required for a chemistry degree.

Chemistry Minor

The requirements to receive a minor in chemistry are 19 hours of chemistry. The 19 hours must include CHM 1014, CHM 1024, CHM 3063, and CHM 3051. The final seven hours can come from: CHM 2084 and/or any 3000/4000 level chemistry courses except for Nutritional Biochemistry (CHM 3313).

Certificate in Forensics

A Certificate in Forensics will enhance career opportunities in law enforcement, the courts and corrections, psychology, chemistry, and computer sciences. A 13-hour list of course work is required for this certificate. This certificate may be coupled with your major and minor to provide you with additional education that can lead to greater responsibility, career advancement and income growth. For further information look in the catalog under Sociology, Human Services, and Criminal Justice.

CHM 2234 Introduction to Forensic Chemistry is required

Courses in Chemistry

CHM 1004 (CHEM1004). Introduction to Chemistry. A general education course for non-science majors. Examines the impact of chemistry on our individual wellbeing, our environment, and the world around us. Serves as an introduction to scientific methods, use of units and measurements and current topics in chemistry. Includes a two hour laboratory in which experiments are performed to demonstrate the principles covered in class. Three (3) hours lecture and two (2) hours of

laboratory each week. May not be taken for credit if a more advanced chemistry course has been completed. Will not count toward major, minor, or teacher certification.

CHM 2234 Introduction to Forensic Chemistry. A course designed to introduce forensic chemistry principles and techniques. This course teaches basic chemical concepts with a focus on forensic science, specifically, how to analyze the evidence found at a crime scene. Includes a two-hour lab during which basic investigative techniques are performed. Will count toward a student's science requirement in the Liberal Arts Core.

CHM 1014 (CHEM1414) University Chemistry I. A course in the principles of chemistry designed for majors in science, and those interested in engineering, medicine, dentistry, optometry, veterinary, medical technology, and pharmacy. Topics covered are atomic theory, chemical reactions, stoichiometry, thermochemistry, periodic properties, bonding, and chemical structure. Three (3) hours lecture, three (3) hours laboratory. Prerequisite: College Algebra or higher math or Math ACT score 22 or above).

CHM 1024 (CHEM1424). University Chemistry II. A course in the principles of chemistry designed for majors in science, and those interested in engineering, medicine, dentistry, optometry, veterinary, medical technology, and pharmacy. Topics include intermolecular forces, solutions and solution properties, equilibria, acid-bases, kinetics, thermodynamics, and electrochemistry. Three (3) hours lecture, three (3) hours laboratory. Students must make a grade of "C" or better in CHM 1014 in order to enroll in CHM 1024.

CHM 1034 (CHEM1214). General Chemistry Non-Majors. An introductory course in inorganic chemistry. Class emphasis is directed toward the needs of students in nursing, family and consumer sciences, and others not majoring in science. Three (3) hours lecture and two (2) hours laboratory. Prerequisite: Completion of math remediation.

CHM 1044 (CHEM1224). General Organic and Biochemistry. An introductory course in organic and biochemistry designed to follow CHM 1034. Does not count toward a major in chemistry nor as a prerequisite for CHM 3063 or 4283. Three (3) hours lecture and two (2) hours laboratory. Prerequisite: CHM 1034 with a grade of "C" or better.

CHM 2084. Quantitative Analysis. The basic methodologies of quantitative analysis with emphasis on chemical equilibrium, the theories of volumetric and gravimetric analysis, and electrochemistry. Some basic instrumentation is covered in the laboratory. Two (2) hours lecture and six (6) hours laboratory. Prerequisite: CHM 1024.

CHM 3051. Organic Chemistry Laboratory I. This course will introduce students to the laboratory techniques normally associated with isolation, purification and analysis of organic compounds. Spectroscopic techniques are introduced and incorporated into the course. Experiments are designed to reinforce the concepts presented in the lecture course. Three (3) laboratory hours. Co-requisite: CHM 3063.

CHM 3063. Organic Chemistry I. A study of the chemistry of carbon-based compounds. Topics covered include bonding, 3-D molecular structure, and mechanisms of functional group reactions. Hydrocarbons, organic halides, alcohols, and ethers are studied. Three (3) hours lecture. Prerequisite: CHM 1024.

CHM 3073. Organic Chemistry II. A study of reactions of functional groups including an in-depth study of carbonyl compounds, and of benzene and related aromatic molecules. Synthetic routes to molecules of biological or pharmaceutical interest will be covered. Three (3) hours lecture. Prerequisite: CHM 3063.

CHM 3131. Organic Chemistry Laboratory II. This course will build on expertise gained in CHM 3051. Additional spectroscopic techniques are introduced. Laboratory experiments emphasize new carbon-carbon bond formation, with an application towards the total synthesis of various molecules. Experiments are designed to reinforce the concepts presented in the lecture course. Three (3) laboratory hours. Co-requisite: CHM 3073.

CHM 3193 Environmental Chemistry. This course is a survey of the natural environment from the chemist's point of view and the evaluation of chemicals from a toxicological perspective. This course will focus on the chemistry of the hydrosphere, geosphere, atmosphere, biosphere and anthrosphere. How pollutants affect the biogeochemical cycles connecting the spheres of the environment will be studied using examples from recent history. Prerequisite: CHM 1024.

CHM 3313. Nutritional Biochemistry. A study of the basic principles of biochemistry applied to human metabolic systems. Three (3) hours lecture. It will be offered every other year (odd years) in the fall. Prerequisite: CHM 1044, or CHM 3063 and CHM 3051 with grades of "C" or better.

CHM 3403. Physical Chemistry for the Life Sciences. A course intended primarily for biology and biochemistry students. The course covers the laws of chemical thermodynamics and their application in bioenergetics, properties of solutions, electrochemistry and electrochemical phenomena in biological systems, chemical spectroscopy and its application in the quantification of biological substances, and chemical kinetics and enzyme kinetics. Three (3) hours lecture. Prerequisites: CHM 3073, PHY 2044 or 2244, and MTH 1294.

CHM 3413. (WI) Introduction to Research. A study of the reference materials available to the chemist and instruction in the use of these sources, and the written and oral presentation of topics searched. Ethical presentation of research and online search techniques are included. Three (3) hours lecture. Prerequisite: CHM 3073.

CHM 3424. Inorganic Chemistry. A survey of inorganic compounds and their reactivity. The structure, bonding and nomenclature of the main group and transition metal compounds will be introduced. The laboratory portion of the course includes the syntheses of a variety of inorganic compounds with emphasis on inert/vacuum atmosphere, and spectroscopy. Three (3) hours lecture, three (3) hours laboratory. Prerequisite: CHM 3073

CHM 4091. Physical Chemistry Laboratory I. Experimental investigation of selected topics from CHM 4113 Physical Chemistry I. Three (3) hours of laboratory. Co-requisite CHM 4113.

CHM 4101. Physical Chemistry Laboratory II. Experimental investigation of selected topics from CHM 4143 Physical Chemistry II. Three (3) hours of laboratory. Co-requisite: CHM 4143.

CHM 4113. Physical Chemistry I. An introduction to chemical thermodynamics, physical and chemical equilibria, electrochemistry, chemical kinetics, and molecular dynamics with applications to environmental and biological chemistry. Three (3) hours lecture. Prerequisite: CHM 2084, CHM 3073, PHY 2244. Co-requisite or prerequisite: MTH 2044.

CHM 4143. Physical Chemistry II. An introduction to quantum mechanics, spectroscopy, computational chemistry, and statistical thermodynamics with applications to chemical systems. Three (3) hours lecture. Prerequisite: CHM 2084, CHM 3073, PHY 2244. Co-requisite or prerequisite: MTH 2044.

CHM 4154. Instrumental Analysis. A study of the theory and use of instrumental methods in chemical analysis. Three (3) hours lecture, three (3) hours laboratory. Prerequisite: CHM 4113 and 4143.

CHM 4164. Radiochemistry. An introduction to natural and artificial radioactivity, radioactive decay processes, the detection and measurement of radiation, interaction of radiation with matter and the use and safe handling of radioisotopes. Three (3) hours lecture and three (3) hours laboratory. Prerequisites: CHM 2084 and MTH 1294.

CHM 4173 Medicinal Chemistry. This course is designed to be an intensive study of the important concepts in medicinal chemistry today as they have evolved over time. The course will be divided into multiple units including analysis of drug targets, pharmacokinetics/pharmacodynamics, drug discovery and design, tools used in drug design and selected topics in med chem. The FDA pharmaceutical clinical evaluation process will also be examined. This course is designed to provide chemistry students with an advanced knowledge of the interdisciplinary nature of chemistry and biology while also serving as a prep course of pharmacy students, and a unique background course for those pursuing medicine. Three (3) hours lecture. Prerequisite: CHM 4283.

CHM 4181-3. (WI) Independent Research. An investigation in the laboratory and literature of a chemical problem under the supervision of a faculty member. Students must consult with the intended faculty mentor before registering for the course. Credit will vary from one to three hours. May be repeated. Prerequisite: consent of instructor.

CHM 4263. History of the Physical Sciences. A study of the development of the physical sciences from its origins to modern times. Three (3) hours lecture. Prerequisite: junior standing or consent of instructor.

CHM 4274. Organic Analysis. The identification of organic compounds by modern techniques. Two (2) hours lecture, six (6) hours laboratory. Prerequisite: CHM 3073.

CHM 4283. Biochemistry I. A survey of the fundamentals of biochemistry including proteins, nucleic acids, lipids, and carbohydrates. Also discussed are the chemical kinetics of enzymes and metabolism. Modern biochemical techniques will also be emphasized. Three (3) hours lecture. Prerequisite: CHM 3073.

CHM 4292. Polymer Chemistry. Introduction to the characterization, synthesis, and chemical properties of polymers. Two (2) hours lecture. Prerequisite: CHM 3073.

CHM 4301. Techniques in Laboratory Management. Experience is given in planning and conducting laboratory courses. Prerequisite: Consent of program director or faculty mentor. May be repeated once.

CHM 4393. Biochemistry II. The course continues the introduction to fundamentals of biochemistry begun in the first semester. Topics will include metabolism, signal transduction, nucleic acid metabolism and information processing. In addition, more advanced aspects of biomolecules and recent advances in the field will be examined. The course is designed for students interested in careers in the biological, chemical, and medical sciences. Three (3) hour lecture course. Prerequisite: CHM 4283.

CHM 4343. Advanced Organic Chemistry. Designed for chemistry majors and others intending to pursue graduate work in chemistry or a closely related field. Modern topics of organic chemistry such as asymmetric synthesis, combinatorial synthesis, organometallic coupling reactions, pericyclic reactions, and photochemistry will be covered with a strong emphasis on current literature. Three (3) hours lecture. Prerequisite: CHM 3073.

CHM 4351-3. Special Topics in Chemistry. This senior level elective is designed for the program to offer courses relevant to an instructor's area of expertise, to offer courses of particular interest to current students, or to address contemporary topics in chemistry not adequately covered elsewhere. May be repeated for up to six hours total, provided topics are different. Course title to appear on transcript. One to three (1 to 3) hour lecture. Prerequisite: Upper-class standing and consent of the instructor.

CHM 4381. Biochemistry Lab. Course covering the fundamental techniques used in the biochemistry laboratory. Separation techniques for proteins, nucleic acids, lipids, and carbohydrates as well as enzyme kinetics and other advanced methods will be examined. Three (3) hours of laboratory. Prerequisite: CHM 3073. Prerequisite or Corequisite: CHM 4283.