

## Chemistry & Biochemistry

### Shinquin Programs of Chemistry and Biochemistry

Professors J. Byrne, Hoppe (Chair) and McGinnis; Associate Professors Rizzolo, Blank, and Frisbie; Assistant Professor Guth; Lecturers Milius, Hoeltge, and Rutkowski.

The Bachelor of Science in Chemistry and the Bachelor of Science in Biochemistry offer thorough and hands on laboratory oriented curricula. Our graduates are highly desired by industry and government employers for their laboratory skills, as well as being well qualified for admission to graduate and professional schools. The courses and labs required for these degrees assure that graduates are proficient in the fundamental principles of chemistry and prepared to apply these principles to specialized areas such as environmental, forensic, medicinal, and pharmaceutical chemistry.

Attainment of the Bachelor of Science in Chemistry requires at least 122 credits as does the Bachelor of Science in Biochemistry. Course work should conform to the following tables since many advanced chemistry courses have other courses as prerequisites. All courses listed in the tables are required, although the sequence varies somewhat for courses

offered in alternate years. It is difficult for chemistry and biochemistry majors to schedule the required courses unless they follow the outline recommended here and pay special attention to the alternate year courses (designated with the symbol §).

The progress of all students majoring in chemistry and biochemistry will be evaluated by the department at the end of the first and second years. Students receiving an unsatisfactory evaluation will be requested to change majors.

In addition to offering a rigorous, quality curriculum in chemistry and biochemistry, the faculty is committed to providing quality instruction in our introductory courses. All of our 100 level courses are consistent with the General Education Goals of the university. These courses provide the student with an introduction to the scientific method, the correct and effective representation of data, and develop the students' critical thinking skills by allowing the analysis and interpretation of experimental data.

*Chemistry courses taken for 3 credits, without a laboratory, will only satisfy free elective or chemistry minor requirements. Chemistry and biochemistry majors must enroll in the 4 credit option of each course required by their major.*

### B.S. in Chemistry - Curriculum Map

First Year			
Fall	Credits	Spring	Credits
CH 103 General Chemistry I	4	CH 104 General Chemistry II	4
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
MA 121 Calculus I	4	MA 122 Calculus II	4
Elective	3	Intro. Computer Science <sup>1</sup>	3
	<b>14</b>		<b>14</b>
Second Year			
Fall	Credits	Spring	Credits
CH 225 Organic Chemistry I or 327 Physical Chemistry I <i>and</i> 337 Physical Chemistry Laboratory I <sup>§</sup>	4	CH 226 Organic Chemistry II or 328 Physical Chemistry II <i>and</i> 338 Physical Chemistry Laboratory II <sup>§</sup>	4
PS 211 University Physics I	4	PS 212 University Physics II	4
EN 201 World Literature I <sup>2</sup>	3	EN 202 World Literature II <sup>2</sup>	3
HI Elective (except HI 209)	3	MA 224 Differential Equations	4
CH 214 Communication in Chemistry (or in 3rd year) <sup>§</sup>	1-0	CH 204 Quantitative Analysis (or Elective) <sup>§</sup>	4-3
	<b>15-14</b>		<b>19-18</b>
Third Year			
Fall	Credits	Spring	Credits
CH 225 Organic Chemistry I or 327 Physical Chemistry I <i>and</i> 337 Physical Chemistry Laboratory I <sup>§</sup>	4	CH 226 Organic Chemistry II or 328 Physical Chemistry II <i>and</i> 338 Physical Chemistry Laboratory II <sup>§</sup>	4
CH 438 Advanced Inorganic Chemistry (or SC/MA Elective) <sup>3, §</sup>	4-3	CH 204 Quantitative Analysis or 314 Instrumental Methods <i>and</i> 315 Analysis Laboratory <sup>§</sup>	4
PS 205 Basic Instrumentation in the Natural Sciences (or Elective) <sup>§</sup>	4-3	CH 324 Biochemistry I (or SC/MA Elective) <sup>3, §</sup>	4-3
Elective	3	Arts or Humanities Elective <sup>4</sup>	3
CH 214 Communication in Chemistry (or in 2nd year) <sup>§</sup>	0-1	Elective	3
	<b>15-14</b>		<b>18-17</b>

Fourth Year			
Fall	Credits	Spring	Credits
CH 421 Chemical Synthesis and Examination I	3	CH 422 Chemical Synthesis and Examination II	3
CH 438 Advanced Inorganic Chemistry (or SC/MA Elective) <sup>3, §</sup>	3-4	CH 314 & CH 315 (or Elective)	3-4
PS 205 Basic Instrumentation in the Natural Sciences (or Elective) <sup>§</sup>	3-4	CH 324 Biochemistry I (or SC/MA Elective) <sup>3, §</sup>	3-4
CH 413 Chemistry Seminar	1	PH Elective in Ethics <sup>6</sup>	3
SS Elective <sup>5</sup>	3	Elective	3
	<b>13-15</b>		<b>15-17</b>
Total Credits: 123			

<sup>1</sup> MA 241 **OR** IS 121 **OR** EG 112 **OR** EG 110

<sup>2</sup> EN 112 or EN 204 may be substituted for one semester of EN 201 - EN 202.

<sup>3</sup> Recommended SC/MA courses: CH 439; MA 223 or MA 310; PS 232, PS 354

<sup>4</sup> An Arts or Humanities course. Use the Arts and Humanities list for this requirement.

<sup>5</sup> Social Science Elective; may enroll in any course in Sociology, Economics, Psychology or Political Science.

<sup>6</sup> A Philosophy (PH) course in ethics. Use the General Education Ethics list for one of the ethics requirements.

<sup>§</sup> This course is offered in alternate years. Both courses listed are required. For the years these courses are offered, see Course Descriptions.

## B.S. in Biochemistry - Curriculum Map

First Year			
Fall	Credits	Spring	Credits
CH 103 General Chemistry I	4	CH 104 General Chemistry II	4
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
MA 107 Precalculus Mathematics	4	MA 121 Calculus I	4
BI 101 Principles of Biology I	4	BI 102 Principles of Biology II	4
	<b>15</b>		<b>15</b>
Second Year			
Fall	Credits	Spring	Credits
CH 225 Organic Chemistry I	4	CH 226 Organic Chemistry II	4
PS 201 General Physics I <sup>1</sup>	4	PS 202 General Physics II <sup>1</sup>	4
EN 201 World Literature I <sup>2</sup>	3	CH 324 Biochemistry I or 204 Quantitative Analysis <sup>§</sup>	4
BI 202 Genetics	4	MA 122 Calculus II	4
CH 214 Communication in Chemistry (or in 3rd year) <sup>§</sup>	1-0		
	<b>16-15</b>		<b>16</b>

Third Year			
Fall	Credits	Spring	Credits
CH 327 Physical Chemistry I (or Elective) <sup>§</sup>	4-3	CH 328 Physical Chemistry II or 324 Biochemistry I <sup>§</sup>	3-4
CH 325 Biochemistry II (or Elective) <sup>§</sup>	4-3	CH 204 Quantitative Analysis or 314 Instrumental Methods <b>and</b> 315 Analysis Laboratory <sup>§</sup>	4
BI 306 Cell Biology (or HI Elective (except HI 209)) <sup>§</sup>	4-3	EN 202 World Literature II <sup>2</sup>	3
SS Elective <sup>3</sup>	3	BI 304 Physiology (or Elective) <sup>5, §</sup>	4-3
PH Elective in Ethics <sup>4</sup>		Elective or in 4th year	3-0
CH 214 Communication in Chemistry (or in 2nd year) <sup>§</sup>	0-1		
	<b>15-13</b>		<b>17-14</b>
Fourth Year			
Fall	Credits	Spring	Credits
CH 327 Physical Chemistry I ( or Elective) <sup>§</sup>	3-4	CH 328 Physical Chemistry II (or Elective) <sup>§</sup>	3
CH 325 Biochemistry II (or Elective) <sup>§</sup>	3-4	CH 314 & CH 315 (or Elective) <sup>§</sup>	4-3
BI 306 Cell Biology (or HI Elective (except HI 209)) <sup>§</sup>	3-4	BI 304 Physiology (or Elective) <sup>§</sup>	3-4
CH 413 Chemistry Seminar <sup>§</sup>	1	CH 422 Chemical Synthesis and Examination II	3
Arts or Humanities Elective <sup>6</sup>	3	Elective or in 3rd year	0-3
	<b>13-16</b>		<b>13-16</b>
Total Credits: 120			

§ This course is offered in alternate years. Both courses listed are required. For the years these courses are offered, see Course Descriptions.

- 1 PS 211 - PS 212 may be substituted for PS 201 - PS 202.
- 2 EN 112 or EN 204 may be substituted for one semester of EN 201 - EN 202.
- 3 Social Science Elective; may enroll in any course in Sociology, Economics, Psychology or Political Science.
- 4 A Philosophy (PH) course in ethics. Use the General Education Ethics list for one of the ethics requirements.
- 5 Recommended Science courses as electives: CH 438.
- 6 An Arts or Humanities course. Use the Arts and Humanities list for this requirement.

## Chemistry Minor

For award of a minor in chemistry students must complete six chemistry courses (of three or more credits), four of which must be above the 100 level. The chemistry minor is not available to those majoring in biochemistry or chemistry.

## Courses

### CH 100 Introduction to Forensic Science 4 Credits

An introductory survey course of Forensic Science/Criminalistics. The course will focus on scientific principles behind the recognition, collection, preservation, analysis, and interpretation of physical evidence found at a crime scene. The emphasis will be put on providing students with an understanding of the capabilities and limitations of forensic science as it is currently practiced. Lecture 3 hours, laboratory 3 hours. Recommended for students not majoring in science and engineering. Offered fall and spring semesters.

### CH 101 Introduction to General Chemistry 4 Credits

CH 101 is the first of a two semester course series in chemistry covering topics in General, Organic and Biochemistry (GOB). It is a fundamental course in general chemistry, introducing students to the principles of chemical structure and reactivity. Topics include accuracy and precision in measurement, atomic and molecular structure, chemical bonding and reactions, and chemical equilibrium. The laboratory element complements the lecture material with emphasis placed on collaborative problem solving. This course is not recommended for students majoring in science or engineering. Prerequisite: a college level mathematics course or equivalent as determined by departmental placement testing. Not more than one of CH 101 or CH 103 may count as degree credit. Lecture 3 hours, laboratory 3 hours. Offered spring semesters.

**CH 102 Introduction to Organic and Biochemistry 4 Credits**

CH 102 is the second part of a two semester course series in chemistry covering topics in General, Organic and Biochemistry (GOB). This course introduces students to the nomenclature, structure and reactivity of organic compounds and the structure and function of the major classes of biological compounds and their role in metabolic pathways. Laboratory exercises compliment the lecture material. This course is not recommended for students majoring in science or engineering. Prerequisites: CH 101 or CH 103. Not more than one of CH 102 or CH 104 may count as degree credit. CH 102 may not be taken for credit after successful completion of CH 205. Lecture 3 hours, laboratory 3 hours. Offered fall semesters.

**CH 103 General Chemistry I 4 Credits**

Introduction to chemical characteristics and behavior, stressing atomic structure, stoichiometry, chemical equilibrium and kinetics, and descriptive chemistry of important elements. Laboratory includes qualitative and quantitative exercises, and syntheses. Lecture 3 hours, laboratory 3 hours. Credit will not be granted for more than one of the following sequences: CH 103 - CH 104, CH 111 - CH 112, or CH 103 - CH 112. Prerequisites: One year of high school chemistry and a score of 2 or better on the Norwich University Mathematics Placement Test or a "C" or better in MA 103. Offered fall semesters.

**CH 104 General Chemistry II 4 Credits**

Continuation of the study of chemical characteristics and behavior, stressing atomic structure, stoichiometry, chemical equilibrium and kinetics, and descriptive chemistry of important elements. Laboratory includes qualitative and quantitative exercises, and syntheses. Lecture 3 hours, laboratory 3 hours. Credit will not be granted for more than one of the following sequences: CH 103 - CH 104, CH 111 - CH 112, or CH 103 - CH 112. Prerequisites: CH 103. Offered spring semesters.

**CH 204 Quantitative Analysis 4 Credits**

A course on the general principles and laboratory practices of quantitative analysis, applied principally in colorimetric and volumetric determinations. Studies of theory and practical procedures associated with gravimetric analysis, potentiometric titrations, and use of pH-meters. Lecture 3 hours, laboratory 4 hours. Prerequisites: CH 103, CH 104. Offered spring semesters of odd numbered years.

**CH 205 Survey of Organic Chemistry 4 Credits**

An introduction to the covalent compounds of carbon. Laboratory work involves elementary manipulation of organic laboratory equipment, preparation and identification of typical organic compounds, and the characteristics of the major functional groups. Lecture 3 hours, laboratory 2 hours. Prerequisites: CH 103 - CH 104. Offered fall semesters of odd numbered years.

**CH 214 Communication in Chemistry 1 Credit**

This course illustrates the organization of the chemical literature, the efficient search of the literature and a formal introduction to scientific writing. Offered fall semesters of even years.

**CH 225 Organic Chemistry I 4 Credits**

An introduction to the study of carbon compounds; preparation and identification of typical compounds. Lecture 3 hours, laboratory 3 hours. Prerequisites: CH 103 - CH 104 or by petition. Offered fall semesters.

**CH 226 Organic Chemistry II 4 Credits**

A continuation of the study of carbon compounds; preparation and identification of typical compounds. Lecture 3 hours, laboratory 3 hours. Prerequisite: CH 225. Offered spring semesters.

**CH 314 Instrumental Methods 3 Credits**

A course on the Theory of Modern Instrumental Methods. Lecture 3 hours. Prerequisites: CH 204 required, CH 327 - CH 328 recommended. Offered spring semesters of even numbered years.

**CH 315 Analysis Laboratory 1 Credit**

A course that provides upper class laboratory experience in chemical methods of measurement and analysis. Laboratory 3 hours. Prerequisite: CH204. Offered spring semesters of even numbered years.

**CH 324 Biochemistry I 4 Credits**

A course on the chemical phenomena and energy effects in life processes. Topics include structure and function of biomolecules, metabolism (catabolism and anabolism), photosynthesis and recombinant DNA technologies. Lecture 3 hours, laboratory 3 hours. Prerequisites: CH 103 - 104, and either CH 205 or co-requisite of CH 226. Offered even numbered spring semesters.

**CH 325 Biochemistry II 4 Credits**

A continuation of the study of the chemical phenomena and energy effects in life processes. Topics include structure and function of biomolecules, metabolism (catabolism and anabolism), photosynthesis and recombinant DNA technologies. Lecture 3 hours, laboratory 3 hours. Prerequisite: CH 324. Offered even numbered fall semesters.

**CH 327 Physical Chemistry I 3 Credits**

A course on the physical properties and structure of matter; general principles and theories of chemical interaction. Major areas studied are chemical applications of thermodynamics; phase equilibria; electrochemistry; reaction kinetics; description of electronic structure of atoms and molecules. Lecture 3 hours. Prerequisites: CH 103 - CH 104; co-requisite; MA 224 and college physics (recommended). Offered even numbered fall semesters.

**CH 328 Physical Chemistry II 3 Credits**

A continuation of the study of the physical properties and structure of matter; general principles and theories of chemical interaction. Major areas studied are chemical applications of thermodynamics; phase equilibria; electrochemistry; reaction kinetics; description of electronic structure of atoms and molecules. Lecture 3 hours. Prerequisite: CH 327. Offered odd numbered spring semesters.

**CH 337 Physical Chemistry Laboratory I 1 Credit**

Laboratory investigations with written formal reports on the physical properties and chemical behavior of substances. Laboratory 3 hours. Prerequisite or co-requisite: CH 327. Offered even numbered fall semesters.

**CH 338 Physical Chemistry Laboratory II 1 Credit**

Laboratory investigations with written formal reports on the physical properties and chemical behavior of substances. Laboratory 3 hours. Prerequisite or co-requisite: CH 328. Offered odd numbered spring semesters.

**CH 413 Chemistry Seminar 1 Credit**

Part of a capstone experience that provides individual assignments, written reports, oral reports, and class discussions on chemical topics of current interest. Reading, writing, speaking and critical thinking skills are emphasized. Lecture 1 hour. Prerequisites: CH 225 - CH 226, CH 327 - CH 328.

**CH 421 Chemical Synthesis and Examination I 3 Credits**

A capstone experience in which organic, inorganic and compounds of biological interest are synthesized and examined with respect to purity and properties. The objectives are to develop an integrated perspective on the general field of chemistry and to develop proficiency in practical laboratory procedures and in reporting results. Laboratory and occasional lectures 8 hours. Prerequisites or co-requisites: CH 225 - CH 226, CH 327 - CH 328. Offered fall semesters.

**CH 422 Chemical Synthesis and Examination II 3 Credits**

A capstone experience in which organic, inorganic and compounds of biological interest are synthesized and examined with respect to purity and properties. The objectives are to develop an integrated perspective on the general field of chemistry and to develop proficiency in practical laboratory procedures and in reporting results. Laboratory and occasional lectures 8 hours. Prerequisites or co-requisites: CH 225 - CH 226, CH 327 - CH 328. Offered spring semesters.

**CH 425 Thesis 1-3 Credit**

This course allows the student to conduct research on a project approved by the faculty of the chemistry and biochemistry programs. The student can be expected to perform the necessary experiments, organize and interpret the data and to communicate the results of the project with a comprehensive report. Prerequisites: CH 225 - CH 226. Co-requisites: CH 327 - CH 328, CH 438. Permission of the program faculty is also required. The student may re-enroll in CH 425 for up to 6 credits.

**CH 438 Advanced Inorganic Chemistry 3 Credits**

A course on the chemistry of the elements: properties, characteristics, and behavior. Lecture 3 hours. Prerequisites: CH 327 - CH 328. Offered fall semesters of odd numbered years.

**CH 439 Advanced Organic Chemistry 3 Credits**

An advanced and thorough development of topics introduced in CH 225 - CH 226. Lecture 3 hours. Prerequisites: CH 225 - CH 226. Offered fall semesters of even numbered years.

**CH 450 Topics in Chemistry 3 Credits**

A course in which a selected limited topic in advanced chemistry is covered in depth. Offered on occasion. Prerequisite: permission of the instructor.