

## Chemistry & Biochemistry

Shinquin Programs of Chemistry and Biochemistry

Professors J. Byrne, Hoppe and McGinnis; Associate Professors Rizzolo, Blank (Chair), 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.

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.

### Goals:

- Graduates are highly desired by industry and government employers for their laboratory skills
- Graduates are well qualified for admission to graduate and professional schools
- 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

### Outcomes:

- Pending

### Careers for these Majors:

- Pending

### B.S. in Biochemistry Curriculum Map

<b>Freshman</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
BI 101 Principles of Biology I	4	BI 102 Principles of Biology II	4
CH 103 General Chemistry I (General Education Lab Science)	4	CH 104 General Chemistry II (General Education Lab Science)	4
EN 101 Composition and Literature I	3	EN 102 Composition and Literature II	3
MA 107 Precalculus Mathematics (General Education Math)	4	MA 121 Calculus I (General Education Math)	4
	<b>15</b>		<b>15</b>
<b>Sophomore</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
BI 202 Genetics	4	CH 226 Organic Chemistry II	4
CH 214 Communication in Chemistry (or in 3rd year)	1-0	CH 324 Biochemistry I or 204 Quantitative Analysis <sup>4</sup>	4
CH 225 Organic Chemistry I	4	PS 202 General Physics II <sup>1</sup>	4
EN 201 World Literature I (General Education Literature) <sup>2</sup>	3	MA 122 Calculus II	4
PS 201 General Physics I <sup>1</sup>	4		
	<b>16-15</b>		<b>16</b>
<b>Junior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
BI 306 Cell Biology (or General Education History) <sup>4</sup>	3-4	BI 304 Physiology (or Free Elective) <sup>4,5</sup>	4-3
CH 214 Communication in Chemistry (or in 2nd year) <sup>4</sup>	0-1	CH 204 Quantitative Analysis or 314 Instrumental Methods (and CH 315 Analysis Laboratory) <sup>4</sup>	4
CH 325 Biochemistry II (or Free Elective) <sup>4</sup>	4-3	CH 328 Physical Chemistry II or 324 Biochemistry I	3-4
CH 327 Physical Chemistry I (or Free Elective) <sup>4</sup>	3	EN 202 World Literature II (General Education Literature) <sup>2</sup>	3
General Education Social Science	3	Free Elective or in 4th year	3-0
General Education Ethics PH Course	3		
	<b>16-17</b>		<b>17-14</b>
<b>Senior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
BI 306 Cell Biology (or General Education History) <sup>4</sup>	4-3	BI 304 Physiology (or Free Elective) <sup>4</sup>	3-4
CH 413 Chemistry Seminar (Capstone) <sup>4</sup>	1	CH 314 Instrumental Methods (and CH 315 or Free Elective) <sup>4</sup>	4-3
CH 325 Biochemistry II (or Free Elective) <sup>4</sup>	3-4	CH 328 Physical Chemistry II (or Free Elective)	3
CH 327 Physical Chemistry I (or Free Elective) <sup>4</sup>	3	CH 422 Chemical Synthesis and Examination II (Capstone)	3
General Education Arts & Humanities	3	Free Elective or in 3rd year	0-3
	<b>14</b>		<b>13-16</b>
<b>Total Credits: 122</b>			

<sup>1</sup> PS 211 - PS 212 may be substituted for PS 201 - PS 202.

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

<sup>4</sup> This course is offered in alternate years. Both courses listed are required. For the years these courses are offered, see Course Descriptions.

<sup>5</sup> Recommended Science courses as electives: CH 438.

## B.S. in Chemistry - Curriculum Map

<b>Freshman</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CH 103 General Chemistry I (General Education Lab Science)	4	CH 104 General Chemistry II (General Education Lab Science)	4
EN 101 Composition and Literature I	3	CS 100 Foundations of Computer Science and Information Assurance	3
MA 121 Calculus I (General Education Math)	4	EN 102 Composition and Literature II	3
Free Elective	3	MA 122 Calculus II (General Education Math)	4
	<b>14</b>		<b>14</b>
<b>Sophomore</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CH 225 Organic Chemistry I or 327 Physical Chemistry I (and CH 337 Physical Chemistry Laboratory I) <sup>4</sup>	4	CH 226 Organic Chemistry II or 328 Physical Chemistry II (and CH 338 Physical Chemistry Laboratory II) <sup>4</sup>	4
EN 201 World Literature I (General Education Literature) <sup>2</sup>	3	PS 212 University Physics II	4
PS 211 University Physics I	4	EN 202 World Literature II (General Education Literature) <sup>2</sup>	3
CH 214 Communication in Chemistry (or in third year) <sup>4</sup>	1	MA 224 Differential Equations	4
General Education History	3	CH 204 Quantitative Analysis (or Free Elective) <sup>4</sup>	4
	<b>15</b>		<b>19</b>
<b>Junior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CH 214 Communication in Chemistry (or in 2nd year) <sup>4</sup>	0-1	CH 226 Organic Chemistry II or 328 Physical Chemistry II (and CH 338 Physical Chemistry Laboratory II) <sup>4</sup>	4
CH 225 Organic Chemistry I or 327 Physical Chemistry I (and CH 337 Physical Chemistry Laboratory I) <sup>4</sup>	4	CH 204 Quantitative Analysis or 314 Instrumental Methods (and CH 315 Analysis Laboratory) <sup>4</sup>	4
CH 438 Advanced Inorganic Chemistry (or SC/MA Elective) <sup>3 4</sup>	3	CH 324 Biochemistry I (or SC/MA Elective) <sup>3 4</sup>	4-3
PS 205 Basic Instrumentation in the Natural Sciences (or Free Elective) <sup>4</sup>	4	General Education Arts & Humanities	3
Free Elective	3	Free Elective	3
	<b>14-15</b>		<b>18-17</b>
<b>Senior</b>			
<b>Fall</b>	<b>Credits</b>	<b>Spring</b>	<b>Credits</b>
CH 413 Chemistry Seminar (Capstone)	1	CH 422 Chemical Synthesis and Examination II (Capstone)	3
CH 421 Chemical Synthesis and Examination I	3	CH 314 Instrumental Methods (and CH 315 or Free Elective)	4-3
CH 438 Advanced Inorganic Chemistry (of SC/MA Elective) <sup>3 4</sup>	4-3	CH 324 Biochemistry I (or SC/MA Elective) <sup>3 4</sup>	4-3
PS 205 Basic Instrumentation in the Natural Sciences (or Free Elective) <sup>4</sup>	4-3	General Education Ethics PH Course	3
General Education Social Science	3	Free Elective	3
	<b>15-13</b>		<b>17-15</b>
<b>Total Credits: 126-122</b>			

<sup>1</sup> MA 241 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> This course is offered in alternate years. Both courses listed are required. For the years these courses are offered, see Course Descriptions.

### Chemistry Minor

This minor is not available to students majoring in Chemistry or Biochemistry.

CH Elective	3
CH Elective	3

CH Elective (200 level or higher)	3
CH Elective (200 level or higher)	3
CH Elective (200 level or higher)	3
CH Elective (200 level or higher)	3
<b>Total Credits</b>	<b>18</b>

## 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 compliments 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 101 - CH 102, or CH 103 - CH 102. Prerequisites: One year of high school chemistry and a score of 2 or higher on the Norwich University Mathematics Placement Test or a "C" or higher 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 101 - CH 102, or CH 103 - CH 102. 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: CH 204. 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, 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.