

# DEPARTMENT OF CHEMISTRY

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260 SCIENCE AND ENGINEERING BUILDING

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**Distinguished professor emeritus:** *Paul Tombouliau*

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**Distinguished professor:** *Michael D. Sevilla*

**Professors:** *Sitaramayya Ari, Maria Szczeniak Bryant, Arthur W. Bull, Denis M. Callewaert, Kathleen Moore, Joel W. Russell, Mark W. Severson, R. Craig Taylor*

**Associate professors:** *Amanda Bryant-Friedrich, Ferman Chavez, Roman Dembinski, Linda Schweitzer, John V. Seeley, Xiangqun Zeng*

**Assistant professors:** *Edith Chopin, John M. Finke, Nesson Joseph Kerrigan*

**Adjunct professors:** *David Becker, Grzegorz Chalasinski, Anna C. Ettinger, Om Goel, Gholam-Abbas Nazri, Fazlul Sarkar*

**Adjunct associate professors:** *John Baldwin, Klaus Friedrich, Ghassan Saed, Stacey K. Seeley*

**Adjunct assistant professors:** *Janet Bennett, Gerald G. Compton, Naomi Eliezer, Jennifer Tillinger*

**Lecturers:** *R. Terry Begnoche, Douglas Herzog, James Leidel, D. David Newlin, Thomas Ott, Hari Prasad, Mark Richardson, William Robert, Cole Shoemaker, Douglas Thiel, Wendy Wilson*

**Chief adviser:** *Jennifer Tillinger*

Oakland University's chemistry programs offer students the laboratories and equipment typically found at larger universities while retaining strong emphasis on the undergraduate education and informal student-faculty relations characteristic of smaller liberal arts colleges. Additionally, research opportunities are available to qualified undergraduates.

The Department of Chemistry provides highly professional chemistry programs, as well as the liberal arts dedication to developing the highest intellectual and creative potential of its students. The department offers programs of study leading to Bachelor of Arts, Bachelor of Science and Master of Science degrees in chemistry and a Doctor of Philosophy degree in biomedical sciences with specialization in health and environmental chemistry.

High school students intending to major in chemistry should refer to the Admissions section of the catalog for specific preparation requirements.

## Planning a program in chemistry

Curricula leading to a major in chemistry are quite structured, since knowledge is developed cumulatively in a four-year sequence. This leads to a fairly prescribed order of course presentation with a number of specific course requirements. Students interested in pursuing a program of study in chemistry should consult with a departmental adviser and file a program plan as early as possible in their college career.

## Admission to major standing

To be eligible for a degree in chemistry, students should be admitted to major standing by the department at least three semesters before graduation. Students must consult with the chemistry department chief adviser and file an application for admission to major standing, which includes a curriculum plan, during the term in which they first take a 300-400 level chemistry course. This procedure is designed to ensure that an appropriate plan of studies is completed by graduation.

Applications for major standing in chemistry will be approved after completion of CHM 157 (or 167), 158 (or 168), 220, 234-235, 237, PHY 151 and MTH 154 with a grade point average of 2.00 or better.

Course work more than 10 years old is subject to re-evaluation by the department. An examination may be required to demonstrate proficiency in areas covered by such courses.

## Requirements for the liberal arts major in chemistry, B.A. program

This curriculum is for students who wish to incorporate a science major into a broader liberal arts program or who wish a foundation in chemistry as a basis for study in chemical physics, medicine and related fields, environmental studies, and technical-legal or technical-business careers. Students interested in sales or management careers in the chemical industry might consider taking the minor in general business offered by the School of Business Administration. Note that either CHM 491 or CHM/BCM 457 (Biochemistry Laboratory) satisfies the university general education requirement for the capstone course.

To earn a Bachelor of Arts degree with a major in chemistry students must be approved for major standing and must complete the core curriculum, which requires a minimum of 44 credits in chemistry and 16 credits of corequisite courses, including:

Core curriculum:		Credits
CHM 157	General Chemistry I	5
CHM 158	General Chemistry II	5
(or 167-168)	Honors General Chemistry I & II	10
CHM 220	Introduction to Computational Chemistry	2
CHM 234	Organic Chemistry I	4
CHM 235	Organic Chemistry II	4
CHM 237	Organic Chemistry Laboratory	2
CHM 325	Analytical Chemistry	4
CHM 342	Physical Chemistry I	4
CHM 343	Physical Chemistry II	4
CHM 348	Physical Chemistry Laboratory	2
CHM 362	Descriptive Inorganic Chemistry	3
CHM 400	Seminar (two semesters)	0
CHM 438	Inorganic/Organic Laboratory	2
BCM/CHM 453	Biochemistry I	3
Corequisite courses:		
MTH 154-155	Calculus	8
PHY 151-152	Introductory Physics	8

CSE 130 is a recommended elective for chemistry majors.

## Requirements for the Bachelor of Science degree with a major in chemistry (ACS certified)

The Bachelor of Science degree with a major in chemistry consists of the core curriculum and corequisite courses plus a set of advanced courses. In selecting advanced courses, students may tailor their programs to fit specific career objectives, such as industrial chemistry, biochemistry, graduate study, research, medicine or dentistry. Students should plan their programs in consultation with a faculty adviser. Advanced course programs must be approved as part of the application for major standing.

To earn a Bachelor of Science degree with a major in chemistry a student must be approved for major standing and must complete the core curriculum, which requires a minimum of 44 credits in chemistry and 16 credits of corequisite courses, plus 8 elective credits in chemistry at the 400 level of which at least two credits must be laboratories. The specific selection of the 8 elective credits in chemistry at the 400 level must be approved in writing by the chemistry department's chief adviser. CHM 491 (3 credits) may be included as part of these elective credits as this course satisfies the university general education capstone requirement. Another option for the general education capstone requirement is BCM/CHM 457 Biochemistry Laboratory (3 credits). The full degree requirements for the Bachelor of Science degree with a major in chemistry are detailed below:

<b>Core curriculum:</b>		<b>Credits</b>
CHM 157	General Chemistry I	5
CHM 158	General Chemistry II	5
(or 167-168)	Honors General Chemistry I & II	10
CHM 220	Introduction to Computational Chemistry	2
CHM 234	Organic Chemistry I	4
CHM 235	Organic Chemistry II	4
CHM 237	Organic Chemistry Laboratory	2
CHM 325	Analytical Chemistry	4
CHM 342	Physical Chemistry I	4
CHM 343	Physical Chemistry II	4
CHM 348	Physical Chemistry Laboratory	2
CHM 362	Descriptive Inorganic Chemistry	3
CHM 400	Seminar (two semesters)	0
CHM 438	Inorganic/Organic Laboratory	2
BCM/CHM 453	Biochemistry	3
Advanced set of chemistry courses (400 or above) (at least 2 credits must be laboratories)		8
<b>Corequisite courses:</b>		
MTH 154-155	Calculus	8
PHY 151-152	Introductory Physics	8

CSE 130 is a recommended elective for chemistry majors.

## American Chemical Society certification

The Department of Chemistry's faculty members, facilities and curriculum meet the criteria of the American Chemical Society. This allows the department to certify chemistry students as eligible for society membership. Certification is granted to students who have successfully completed the requirements for the Bachelor of Science degree with a major in chemistry.

## Requirements for the major in engineering chemistry, B.S. program

**Coordinator:** *Ching L. Ko (Engineering)*

The program in engineering chemistry, which is offered by the Department of Chemistry in cooperation with the School of Engineering and Computer Science, leads to the Bachelor of Science degree with a major in engineering chemistry. It is intended for well-qualified students who seek a basic preparation in engineering along with a highly professional chemistry program. Requirements include:

1. MTH 154, 155, 254; APM 255 (or 257) and PHY 151-152.
2. CHM 157-158 (or 167-168 or 162-163), 234-235, 237, 325, 342-343, 348 and 471; one lecture or laboratory course (2 or 3 credits) above CHM 400.
3. EGR 120, 141, 240, 250, 260, 280; ME 331; choice of 8 credits from ME 438, 439, 448, 449, 456, 457 and 482.

Students in this program are not required to complete the College of Arts and Sciences distribution requirements. Students must complete the university's general education, including the capstone course of either CHM 491 or ME 490 (see *Undergraduate Degree Requirements*).

In addition to the previously stated requirements, satisfactory completion of the program requires an average grade of at least 2.0 in the courses taken to satisfy the engineering and chemistry requirements and in the courses prescribed for the mathematics, physics and computer science requirements. For limitations on free electives see the Policies on Electives section in the School of Engineering and Computer Science portion of the catalog.

## Secondary Teacher Education Program (STEP): Chemistry

**Adviser:** *John V. Seeley*

The Secondary Teacher Education Program (STEP) at Oakland University is an extended program of study leading to certification. Generally, eligibility for admission to the STEP requires a GPA of 3.00 in both major and minor, and an overall GPA of 2.80. No single major or minor course grade may be below 2.0. Second-undergraduate degree candidates completing major and/or minors may be required to complete additional course work at Oakland University beyond the stated minimums. Students in this program must complete the requirements for a B.A. or B.S. degree in chemistry in the College of Arts and Sciences and concurrently fulfill the major requirements listed below:

1. one course in earth science, such as PHY 106 or ENV 308, 373;
2. one course in science, technology and society, CHM 300;
3. one biology course, BIO 111 or some other course approved by the STEP adviser.

A program in STEP must include either a 20-28 credit secondary teaching minor or an integrated science endorsement. Furthermore, STEP Chemistry majors must also complete a sequence of undergraduate course work in education to include SED 300, FE 345, RDG 538 and SED 427.

Extended study including SED 428, 455 and SE 501 is also required. Further details on program and admission requirements and procedures can be found in the School of Education and Human Services portion of the catalog and by consulting advisers in the Department of Chemistry and the School of Education and Human Services Advising Office, 363 Pawley Hall, (248) 370-4182.

## Secondary Teacher Education Program (STEP): Endorsement in Integrated Science

Students pursuing the STEP Chemistry major are eligible to pursue an Integrated Science endorsement. Students who complete both the STEP Chemistry major and the STEP Integrated Science program will be recommended for certification by Oakland University to teach the following subjects at the secondary level: Biology, Chemistry, Earth Science, Life Science, Physical Science and Physics. This program may be substituted for a secondary teaching minor. Students must complete the STEP Chemistry major and also have taken the following courses:

BIO 111, BIO 113, CHM 157, CHM 158, CHM 234, ENV 308, PHY 151/101, PHY 152/102, PHY 104, PHY 106/GEO 106.

STEP Chemistry majors should note that many of the courses listed above may have already been taken in the process of completing the STEP Chemistry major.

A cumulative grade point average of 3.00 is required in courses in the program, with no single course grade below 2.0. Second undergraduate degree candidates completing the program may be required to take additional courses at Oakland University beyond the stated minimums. Students must consult with the STEP Chemistry adviser.

## Research

The Department of Chemistry offers exceptional opportunities year-round for interested and qualified students to participate in faculty research. Course credit for research may be earned in CHM 290, 490 and 491. In addition, employment opportunities or fellowships are often available. Such research experience is of particular value to students preparing for graduate study or industrial employment.

Students should feel free to discuss research opportunities with members of the chemistry faculty. Specific arrangements with an individual faculty member must be made before enrollment in CHM 290, 490 or 491.

## Departmental Honors

Departmental honors may be awarded to graduating seniors in chemistry who have been recommended for honors by their research advisers and have completed all required science courses with high grades.

## Advanced Courses in Chemistry

Students pursuing a major in chemistry, B.S. program, take 8 credits of advanced courses in areas of interest. In addition to the courses listed in this catalog, the following advanced courses are open to qualified undergraduates: CHM 521 and 522, Advanced Analytical Chemistry and Topics in Analytical Chemistry; CHM 534 and 535, Advanced Organic Chemistry and Topics in Organic Chemistry; CHM 540, Symmetry in Chemistry; CHM 541 and 542, Advanced Physical Chemistry and Topics in Physical Chemistry; CHM 553 and 554, Advanced Biochemistry and Topics in Biochemistry; and CHM 563 and 564, Advanced Inorganic Chemistry and Topics in Inorganic Chemistry. See the *on-line Oakland University Graduate course listings* for course descriptions.

## Biochemistry Program

In cooperation with the Department of Biological Sciences, the Department of Chemistry offers a Bachelor of Science degree with a major in biochemistry. Courses used to fulfill the requirements for a major in biochemistry may not be used simultaneously to fulfill the requirements for a major or minor in chemistry.

## Requirements for the liberal arts minor in chemistry

Students in other departments or the Bachelor of General Studies program who wish to minor in chemistry must take CHM 157-158 (or 167-168), 234-235, 325 and 342. A minimum of 8 credits in chemistry must be earned at Oakland University. An approved concentration/minor authorization form must be filed three semesters prior to graduation.

## Requirements for the secondary teaching minor in chemistry

A minimum of 20 credits in chemistry is required for the secondary teaching minor in chemistry. Students transferring equivalent courses must still meet this 20-credit minimum. These must include CHM 157-158 (or 167-168), plus CHM courses from one of the following two options:

1. CHM 234, 220 and 325. This option is restricted to students who also take BIO 325 (e.g., biology majors).
2. CHM 201, 220 and 325. Non-biology majors would normally select this option.

Non-science majors must complete an additional 4 credits in science for a total of 24 credits. In addition SED 427, Methods of Teaching Secondary Students (chemistry), is required.

Generally, a cumulative grade point average of 3.00 is required in courses in the minor, with no single course grade below 2.0. Second undergraduate degree candidates completing the minor may be required to take additional courses at Oakland University beyond the stated minimums. Students must consult with the secondary education minor adviser in the department.

## Pre-medical studies concentration: medicine, dentistry, optometry and veterinary medicine

The Bachelor of Science degree with a major in biochemistry provides students with all the requirements for a pre-medical studies concentration with the exception of PHY 158, which needs to be completed. The Bachelor of Science degree and the Bachelor of Arts degree with a major in chemistry provide students with all the requirements for a pre-medical studies concentration with the exception of PHY 158, which must be completed, and five courses in biology/biochemistry. Students interested in a medical career should refer to the pre-medical studies concentration in medicine, dentistry, optometry and veterinary medicine (Other Academic Options) and consult with the chemistry or biochemistry adviser and with the pre-medical studies adviser.

## Course Offerings

The department offers selected courses from this catalog as warranted by student needs and availability of faculty. Specific offerings for each term may be found in the *Schedule of Classes*.

The various introductory chemistry courses (104, 143, 157, 162 and 167) are for students in different majors with different levels of mathematical and physical science preparation. Students who do not place in MTH 012 or a higher MTH course are advised to complete MTH 011 prior to enrolling in any chemistry course. Students must consult with the chemistry department adviser or their major adviser before enrolling in 104 or 143.

CHM 104 is designed primarily for pre-nursing students. Computer science and engineering students may enroll in CHM 143, 157, 162 or 167. Science majors (biology, biochemistry, chemistry, environmental health, physics) and students majoring in the health sciences should enroll in CHM 157 or 167. CHM 162 and CHM 167 are recommended for students with a strong preparation in chemistry and physics.

CHM 157-158 or CHM 167-168 are prerequisite to all higher chemistry courses except CHM 201 and 300. Credit will be allowed for only one of each of the following series of courses: CHM 104, 143, 157, 162 or 167 and CHM 158, 163 or 168. Credit will not be allowed in major and minor programs in chemistry, biology or physics for CHM 201 and 300, except for CHM 300, which is allowed for the STEP majors in biology and chemistry.

**SCI 100 Physical Sciences in Life, the World and Beyond (4)**

Interdisciplinary physical science course for non-science majors to enhance their scientific literacy and experience the scientific approach to problem solving in active-learning classrooms and hands-on and computer laboratories. Modules on the science of everyday life, science of the microscopic world, and the earth and beyond. *Satisfies the university general education requirement in the natural science and technology knowledge exploration area.*

Prerequisite: MTH 012 with a grade of 2.0 or higher or placement in higher level math course.

**CHM 104 Introduction to Chemical Principles (4)**

Study of principles of general chemistry. Prepares students for CHM 201. Recommended preparation: high school algebra and chemistry. *Satisfies the university general education requirement in the natural science and technology knowledge exploration area.* Students must attend three general education laboratory sessions during the semester.

Prerequisite: MTH 011 with a minimum grade of 2.0 or placement in MTH 012 or higher MTH course.

**CHM 143 Chemical Principles (4)**

States of matter, atomic structure, bonding and molecular structure, chemical reactions. This course has common lectures with *CHM 157*. *CHM 143 does not satisfy the university general education requirement in the natural science and technology knowledge exploration area.* Recommended preparation is three years of high school mathematics and one year of high school chemistry. Restricted to engineering and computer science majors.

Prerequisite: score of 20 or higher on ACT mathematics exam; or MTH 012.

**CHM 147 General Chemistry Laboratory I (1)**

Experimental investigation of chemical phenomena and measurements. This laboratory will not appear in the schedule of classes; students must obtain permission from the chemistry department adviser to register.

Prerequisite: CHM 144 and permission of chemistry adviser.

**CHM 148 General Chemistry Laboratory II (1)**

Training in the basic techniques of chemistry experimentation. This laboratory will not appear in the schedule of classes; students must obtain permission from the chemistry department adviser to register.

Prerequisite: CHM 145, 147 and permission of chemistry adviser.

**CHM 157 General Chemistry I (5)**

Integrated lecture-laboratory. States of matter, atomic structure, bonding and molecular structure, chemical reactions. Recommended preparation is three years of high school mathematics and one year of high school chemistry. *CHM 157 satisfies the university general education requirement in the natural science and technology knowledge exploration area.*

Prerequisite: score of 20 or higher on ACT mathematics exam or MTH 012.

**CHM 158 General Chemistry II (5)**

Integrated lecture-laboratory. Chemical reactions, kinetics, equilibrium, acid-base chemistry, thermodynamics and electrochemistry.

Prerequisite: CHM 144 and 147 or 157.

**CHM 162 Honors General Chemistry for Engineers I (4)**

Intensive introduction to chemistry in a small-class setting including selected research areas in chemistry. This course has common lectures with CHM 167 and is recommended for engineering majors with strong high school preparation in chemistry, physics and mathematics. *CHM 162 does not satisfy the university general education requirement in the natural science and technology knowledge exploration area.*

Prerequisite: one year of high school chemistry and physics and placement in MTH 154 or higher or math ACT score of 25 or higher.

**CHM 163 Honors General Chemistry for Engineers II (4)**

A more intensive treatment of the topics in CHM 158 including selected research areas in chemistry in a small-class setting. This course has common lectures with CHM 168.

Prerequisite: CHM 162 or 167.

**CHM 167 Honors General Chemistry I (5)**

Integrated lecture-laboratory. A more intensive introduction to the topics in CHM 157 including selected research areas in chemistry in a small-class setting. *CHM 167 satisfies the university general education requirement in the natural science and technology knowledge exploration area.*

Prerequisite: one year of high school chemistry and physics and placement in MTH 154 or higher or math ACT score of 25 or higher.

**CHM 168 Honors General Chemistry II (5)**

Integrated lecture-laboratory. A more intensive treatment of the topics in CHM 158 including selected research areas in chemistry in a small-class setting.

Prerequisite: CHM 157 or 167.

**CHM 201 Introduction to Organic and Biological Chemistry (4)**

Brief survey of organic and biological chemistry, emphasizing applications to human physiology. CHM 201 may not be used for major or minor credit in chemistry, biology or physics, except for the STEP minor in chemistry.

Prerequisite: CHM 104.

**CHM 220 Introduction to Computational Chemistry (2)**

An introduction to the use of modern computational methods for the solution of chemical problems, with emphasis on the use of high-level software packages. Topics include elementary computational procedures, statistical treatment of experimental data, graphical methods, and an introduction to molecular modeling. No computer programming experience required.

Prerequisite: CHM 158 or 168; MTH 154 or MTH 122 recommended.

**CHM 234 Organic Chemistry I (4)**

Introduction to the structure, properties and reactivity of organic compounds.

Prerequisite: CHM 158 or 168.

**CHM 235 Organic Chemistry II (4)**

A continuation of CHM 234. A study of the organic chemistry of functional groups and an introduction to biologically important organic compounds.

Prerequisite: CHM 234.

**CHM 237 Organic Chemistry Laboratory (2)**

Basic organic laboratory manipulations at the semi-micro level, synthesis, spectroscopy and chromatography.

Prerequisite: CHM 158 or 168 and CHM 234. CHM 234 may be taken concurrently in summer semester only.

**CHM 290 Introduction to Research (1, 2, 3 or 4)**

Introduction to laboratory research for students with no previous research experience. May be repeated for credit. Graded S/U.

Prerequisite: permission of instructor.

**CHM 300 Chemistry and Society (4)**

Designed for non-science majors and STEP chemistry majors and minors. Applies chemistry to environmental topics including smog, ozone depletion, global climate changes, water pollution, acid rain,

fossil fuel and nuclear and alternative energies. Several in-class laboratory experiences included. *Satisfies the university general education requirement in the natural science and technology knowledge exploration area. Satisfies the university general education requirement for a writing intensive course in general education or the major, not both.*

Prerequisite: Completion of the university writing foundation requirement.

**CHM 325 Analytical Chemistry (4)**

Acid-base, complexation, precipitation, oxidation-reduction and phase-distribution principles, along with fundamentals of spectroscopy, chromatography and statistics, are studied and applied to chemical analysis. Four hours of lecture and eight hours of laboratory per week.

Prerequisite: CHM 158 or 168.

**CHM 342 Physical Chemistry I (4)**

Kinetics, applications of thermodynamics to chemical systems and equilibria.

Prerequisite: CHM 158 or 168, MTH 155 and PHY 152.

**CHM 343 Physical Chemistry II (4)**

Introduction to quantum mechanics, statistical mechanics and molecular spectroscopy. This course may be taken before CHM 342.

Prerequisite: CHM 158 or 168, MTH 155 and PHY 152.

**CHM 348 Physical Chemistry Laboratory (2)**

Experiments in thermodynamics, kinetics, phase equilibria and advanced spectroscopy with emphasis on mathematical treatment of experimental data. *Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*

Prerequisite: CHM 220, 325, and 342 or 343.

**CHM 362 Descriptive Inorganic Chemistry (3)**

Structure, bonding and reactivity of inorganic compounds.

Prerequisite: CHM 235.

**CHM 400 Seminar (0)**

Discussions of recent advances and topics of current interest; reports. Graded S/U.

Prerequisite: junior or senior standing.

**CHM 410 Environmental Chemistry (3)**

Concepts from atmospheric and aquatic chemistry as it is applied to the environment such as photochemistry, global warming, ozone depletion, carbon cycle, equilibrium principles, acids and bases, complexation and dissolution, and electron transfer processes. Current topics in environmental issues and analytical methods will be discussed.

Prerequisite: CHM 234.

**CHM 412 Atmospheric Chemistry (3)**

Chemistry of atmospheric gases and aerosols. Environmental issues (stratospheric ozone depletion, global warming, photochemical smog, acid rain, biosphere/atmosphere interactions). Concepts (lifetimes, sources, sinks, transport, global cycles). Social issues (air quality standards, effects of air pollutants). Measurement techniques.

Prerequisite: CHM 342.

**CHM 413 Environmental Aquatic Chemistry (3)**

Applications of inorganic and organic chemistry in natural waters pertaining to environmental concerns. Topics include acid-base reactions, buffer systems, mineral precipitation, chemical complexation, redox

reactions, adsorption phenomena, chemical-equilibria, and the influence of organic chemicals on transfer and reaction processes in the environment.

Prerequisite: CHM 234.

**CHM 426 Instrumental Analysis (3)**

An integrated examination of contemporary analytical instrumentation including spectroscopy, electrophoresis, chromatography and mass spectrometry. Emphasis is placed on developing a functional understanding through the analysis of samples typical of those examined in industrial laboratories. Two hours of lecture and four hours of laboratory per week.

Prerequisite: CHM 325.

**CHM 427 Electrochemistry (3)**

Survey of electroanalytical and spectroelectrochemical methods. Includes microelectrodes and selective electrodes in bioelectrochemistry as well as electrical phenomena at the biological membrane level.

Prerequisite: CHM 325.

**CHM 432 Advanced Organic Chemistry (3)**

Selected topics in synthetic, structural and physical-organic chemistry.

Prerequisite: CHM 235.

**CHM 438 Inorganic/Organic Laboratory (2)**

Synthesis, analysis and characterization of organic and inorganic compounds.

Prerequisite: CHM 237 and 362.

CHM 362 may be taken concurrently.

**CHM 444 Advanced Physical Chemistry (3)**

Introduction to statistical mechanics. Applications of quantum and statistical mechanics to chemical bonding, molecular structure and spectroscopy.

Prerequisite: CHM 342, 343 and MTH 254.

**CHM 453 Biochemistry I (3)**

First course in a comprehensive biochemistry sequence. Structure and function of proteins, carbohydrates and lipids; enzyme mechanisms, kinetics and regulation; bioenergetics and catabolism. Identical with BCM 453.

Prerequisite: CHM 235.

**CHM 454 Biochemistry II (3)**

Metabolic pathways and control; nucleic acid structure, function and processing, including regulation of gene expression. Selected topics in molecular physiology. Identical with BCM 454.

Prerequisite: CHM/BCM 453.

**CHM 457 Biochemistry Laboratory (3)**

Techniques of extraction, separation, identification and quantification of biomolecules, including electrophoresis, chromatography and radioisotope techniques, with emphasis on mathematical treatment of experimental data. Identical with BCM 457. *Satisfies the university general education requirement for the capstone experience. Satisfies the university general education requirement for a writing intensive course in the major. Prerequisite for writing intensive: completion of the university writing foundation requirement.*

Prerequisite: CHM/BCM 453, which may be taken concurrently.

**CHM 458 Biochemistry Projects (2)**

Advanced project-oriented instruction in biochemical laboratory techniques.

Prerequisite: CHM 457 and permission of instructor.

**CHM 463 Inorganic Chemistry (3)**

Structure, bonding and reactivity of inorganic and organometallic compounds, with emphasis on transition elements and selected main group elements.

Prerequisite: CHM 362.

**CHM 470 Industrial Chemistry (3)**

Survey of the major sources and uses of chemicals, industrial chemical processes, fundamental raw materials and career paths available in the chemical industry. More intensive treatment of selected industrial processes.

Prerequisite: CHM 235.

**CHM 471 Structure and Synthesis of Polymers (3)**

Preparation, properties and structure of selected inorganic and organic polymers. Both chemical theory and technological applications will be discussed.

Prerequisite: CHM 235.

**CHM 472 Chemical and Physical Properties of Polymers (3)**

The molecular principles governing the physical behavior of macromolecules in solution and in the glassy and crystalline states. The mechanical behavior and structure of macromolecules.

Prerequisite: CHM 471 and 343 or permission of instructor.

**CHM 477 Macromolecular Laboratory (2)**

Introduction to the synthesis and physical characterization of synthetic polymers.

Prerequisite: CHM 237 and CHM 471; CHM 471 may be taken concurrently.

**CHM 480 Selected Topics (1, 2, 3 or 4)**

Advanced study in selected areas; normally involves preparation of a term paper or presentation of a seminar. May be repeated for credit.

Prerequisite: permission of instructor.

**CHM 486 Physical-Analytical Projects (1 or 2)**

Advanced experimentation in physical or analytical chemistry, with at least four hours per week per credit.

Prerequisite: permission of instructor.

**CHM 487 Synthesis Projects (1 or 2)**

Advanced synthesis work emphasizing modern techniques, with at least four hours per week per credit.

Prerequisite: permission of instructor.

**CHM 490 Research (1, 2, 3, 4, 6 or 8)**

Laboratory practice in undergraduate research, with at least four hours per week per credit. May be repeated for credit. Cannot be used to satisfy the chemistry major requirements for 400-level courses. Graded S/U.

Prerequisite: permission of instructor.

**CHM 491 Independent Research (3)**

Undergraduate research with at least eight hours per week in the laboratory. Requires a written report. *Satisfies the university general education requirement for the capstone experience.*

Prerequisite: junior standing. Permission of instructor.

**CHM 497 Apprentice Chemistry Teaching (1 or 2)**

Supervised participation in teaching undergraduate or high school courses in chemistry. May be repeated once for credit.

Prerequisite: permission of instructor.