CHEMISTRY (INSTRUCTIONAL TRACK)

The Bachelor of Science in Chemistry (instructional track) is an interdisciplinary program for students who wish to teach chemistry and other science courses at the secondary school level. The program meets State of Michigan requirements as well as American Chemical Society (ASC) recommendations for teaching chemistry in high school. A student may earn a Bachelor of Science degree in Chemistry and qualify for a Michigan Secondary Standard Teaching Certificate by completing the professional sequence of education courses including one semester of directed teaching; by completing the prerequisite, major, cognate requirements and by fulfilling the Dearborn Discovery Core (DDC) graduation requirements. Students must also complete at least 100 credit hours of non-education courses; have a minimum 2.75 overall GPA; have a 2.75 or better GPA in their teaching major and in education courses; and have a 2.75 in their optional teaching minor, if desired. Students must take the Michigan Test for Teacher Certification (MTTC) prior to being recommended for a Michigan teaching certificate.

In addition to the major requirements, students must complete all CASL Degree Requirements (http://catalog.umd.umich.edu/undergraduate/college-arts-sciences-letters/).

Prerequisites to the Major

Chemistry/Instructional Track majors must complete 40 credit hours of prerequisite courses. These courses should be completed early in the student's curriculum.

Code	Title	Credit Hours
Select one of the following:		8
CHEM 134 & CHEM 136	General Chemistry IA and General Chemistry IIA (OR)	
CHEM 144 & CHEM 146	Gen Chemistry IB and General Chemistry IIB	
CHEM 225	Organic Chemistry I	3
CHEM 226	Organic Chemistry II	3
CHEM 227	Organic Chemistry Laboratory	2
BIOL 130	Intro Org and Environ Biology [1]	4
or BIOL 140	Intro Molec & Cellular Biology	
MATH 115	Calculus I	4
MATH 116	Calculus II	4
MATH 215	Calculus III	4
or MATH 205	Calc III for Engin Students	
PHYS 150 & PHYS 151	General Physics I and General Physics II [2]	8
Total Credit Hours		40

[1] Students interested in biochemistry should elect BIOL 140; students interested in environmental chemistry should elect BIOL 130.

[2] The physics prerequisite may also be satisfied by completing PHYS 125 and PHYS 126 **and** an upper-level physics course, such as PHYS 305. The upper level PHYS course used in this substitution **cannot** be used toward the cognate requirement.

Major Requirements

Students must complete 20 credit hours of upper-level chemistry courses as indicated:

Code	Title	Credit Hours
Required Courses		
CHEM 303	Inorganic Chemistry I	3
CHEM 344	Quantitative Analysis	4
CHEM 368	Physical Chemistry I	3
Select one of the following:		3-4
CHEM 403	Inorganic Chemistry II	
CHEM 447	Instrumental Methods of Analys	
CHEM 469	Physical Chemistry II	
Select one labatory course from the following:		1-2
CHEM 450	Adv Org Syn & Character Lab	
CHEM 452	Adv Inorg Synth & Char Lab	
CHEM 481	Physicochemical Measurements	
Electives		
Select additional courses to bring the upper-level chemistry total to 20 hours, from the following:		
CHEM/ESCI 348	Environmental Chemistry	
CHEM/ESCI 349	Environmental Chem Laboratory	
CHEM/BCHM/ ESCI 352	Introduction to Toxicology	
CHEM/BCHM/ BIOL 370	Principles of Biochemistry	
CHEM 390	Current Topics in Chemistry	
CHEM 403	Inorganic Chemistry II	
CHEM 426	Advanced Organic Chemistry	
CHEM 435	Green Chemistry	
CHEM 436	Polymer Chemistry	
CHEM 447	Instrumental Methods of Analys	
CHEM 450	Adv Org Syn & Character Lab	
CHEM 452	Adv Inorg Synth & Char Lab	
CHEM 469	Physical Chemistry II	
CHEM 481	Physicochemical Measurements	
CHEM 497	Seminar in Chemistry	
Cognates		
Chemistry/Instructional Track majors must complete at least six credit hours of courses numbered 300 or above offered in Biochemistry (BCHM), Biological Sciences (BIOL), Environmental Science (ESCI), Geology (GEOL), Mathematics (MATH), Microbiology (MICR), Physics (PHYS), or Statistics (STAT). The six credit hours need not be from a single discipline. [1]		6
Total Credit Hours		20-22

[1] Excluding MATH 385, MATH 386, MATH 387, MATH 442, MATH 443, MATH 444, MATH 447, MATH 448, MATH 486.

Notes:

1. A maximum of 44 hrs. in CHEM (excluding CHEM 134, CHEM 136, CHEM 144, CHEM 146) may count in the 120 required for graduation.

2. At least 12 of the 20 upper level hours in CHEM must be elected at UM-Dearborn.
3. CHEM 470 and 471 can be used in place of CHEM 370, however, CHEM 470 alone cannot be used for this substitution. Students cannot take both CHEM 370 and CHEM 470 or CHEM 471 or any combination to fulfill major, cognate or minor requirements.
4. The Chemistry Instructional major is open only to students who have been admitted to the College of Education, Health, and Human Services Secondary Certification Program.
5. A maximum of 6 hrs. of independent study/research in any Dept. of Natural Sciences discipline may count towards the 120 hours required to graduate.

Education Requirements

Please see the College of Education, Health, and Human Services (CEHHS) section of this Catalog for secondary certification requirements. (https://umdearborn.edu/cehhs/undergraduate-programs/areas-study/undergraduate-degree-programs/secondary-grades-6-12-certification/)

Teaching Minor Requirements

In order to obtain teaching certification, a student must complete the requirements for a teaching minor. Courses used to satisfy requirements for the minor and prerequisite may not be used to satisfy cognate or major requirements.

Teaching minors are available in mathematics, physical science, physics, and biology. Students should consult the College of Education, Health, and Human Services section in this *Catalog* for coursework requirements to complete the teaching minor (https://umdearborn.edu/cehhs/undergraduate-programs/areas-study/undergraduate-degree-programs/secondary-grades-6-12-certification/).

CHEM 090 Introduction to Chemistry 3 Credit Hours
An introductory course in chemistry stressing fundamental principles of chemistry and the application of mathematics to chemistry and problem-solving. Topics will include chemical formulas and equations, stoichiometry, descriptive inorganic chemistry, behavior of gases and atomic structure. Students with high school chemistry and three years of high school mathematics should elect CHEM 114. Three hours lecture. (F).

CHEM 091 Introduction to Chemistry II 3 Credit Hours
The course is designed for the Chemistry 134/144 student whose background in chemistry is inadequate for success in 134/144. This course will be offered concurrently with Chem 090 (Introduction to Chemistry). It will begin after the first Chem 134/144 exam and will encompass the final nine weeks of the term. Topics will include chemical formulas and equations, stoichiometry, descriptive inorganic chemistry, behavior of gases, and atomic structure.

CHEM 100 Chemistry and Society 4 Credit Hours
An introductory course for nonscientists that examines the way chemistry impacts our world. The course will focus not only on what modern chemistry has accomplished, but more generally on the way scientists think and how they function. Topics include (a) air and water pollution, the ozone layer, global warming, acid rain, and other environmental chemistry; (b) the chemistry of plastics and polymers; (c) the chemistry of drugs and medicines; and (d) biochemistry and biotechnology. Other topics include the influence of the media on scientific issues and the decision-making process in science. Three hours lecture, three hours lab. (YR).

CHEM 124 General Chemistry I 4 Credit Hours
An introduction to phenomena and principles of chemistry with emphasis on developing an understanding of the fundamentals of chemical processes. Concepts to be explored are chemical reactions, thermodynamics, equilibria, and kinetics. For students considering careers in life sciences, physical sciences and engineering. Three hours lecture, one hour recitation, three hours laboratory. Prerequisites are one year of high school chemistry and previous or concurrent enrollment in MATH 104 or 105. (F,W,S).
Prerequisite(s): MATH 104* or MATH 105* or Mathematics Placement with a score of 113
Corequisite(s): CHEM 124L

CHEM 134 General Chemistry IA 4 Credit Hours
An introduction to chemical phenomena and principles with an emphasis on developing both an understanding of chemistry. Students will investigate the fundamentals of chemistry in the context of real-world problems and will utilize systems of biological and environmental importance. Core concepts include stoichiometry, aqueous chemistry, gas laws, thermochemistry, atomic structure, molecular structure and bonding. Three hours lecture, one hour recitation, three hours laboratory. Primarily designed for students considering careers in life sciences or physical sciences. (F, S, W).
Prerequisite(s): MATH 104* or MATH 105* or MATH 113* or MATH 115* or Mathematics Placement with a score of 105 or Mathematics Placement with a score of 115

CHEM 136 General Chemistry IIA 4 Credit Hours
Continuation of CHEM 134. Concepts explored include conceptual and quantitative treatments of intermolecular forces, physical properties of solutions, chemical kinetics, chemical equilibria, acid-base equilibrium, thermodynamics, and electrochemistry. Primarily designed for students majoring in the physical sciences and the life sciences. (F,W,S)
Prerequisite(s): CHEM 134

CHEM 144 Gen Chemistry IB 4 Credit Hours
This course consists of an introduction to chemistry, its phenomena, and principles explored in the context of real-world examples (e.g. the automobile). Core concepts include states of matter, atomic and electronic structure, types of reactions (acid-base and reduction-oxidation), structure and bonding, gas laws, stoichiometry, thermodynamics, chemical equilibrium, and the chemical composition of the atmosphere and air pollution problems. Three hour lecture, one hour recitation, three hours laboratory. Primarily designed for students considering careers in engineering. (F)
Prerequisite(s): MATH 105* or Mathematics Placement with a score of 113 or Mathematics Placement with a score of 115

CHEM 146 General Chemistry IIB 4 Credit Hours
Continuation of CHEM 144. This course consists of an introduction to chemistry, its phenomena, and principles explored in the context of real-world examples (e.g. the automobile). Core concepts to be explored include the solid state, chemical kinetics, electrochemistry and its applications (e.g. batteries, fuel cells, and corrosion), an introduction to organic functional groups, their reactions, and spectroscopic identification, and the preparation and properties of synthetic polymers. Primarily designed for students considering careers in engineering. (W)
Prerequisite(s): CHEM 144

CHEM 225 Organic Chemistry I 3 Credit Hours
The initial course in organic chemistry. A general introduction to organic chemistry with emphasis on the development of structure theory and functional group chemistry. Three hours lecture, one hour recitation. (F,S).
Prerequisite(s): CHEM 136 or CHEM 146
Corequisite(s): CHEM 225R

CHEM 225R Organic Chemistry I Recitation 0 Credit Hours
Recitation component of CHEM 225. Must be taken concurrently with CHEM 225.
Corequisite(s): CHEM 225

CHEM 226 Organic Chemistry II 3 Credit Hours
A continuation of CHEM 225. Topics include functional group chemistry and properties of carbohydrates, amino acids, and aromatic compounds. Three hours lecture, one hour recitation. CHEM 225 and 226 constitute a two-semester sequence in organic chemistry, suitable for students in the basic sciences or engineering or with interests in one of the health professions. (W,S).
Prerequisite(s): CHEM 225
Corequisite(s): CHEM 226R

CHEM 226R Organic Chemistry II Rec 0 Credit Hours
Recitation component of CHEM 226. Must be taken concurrently with CHEM 226.
Corequisite(s): CHEM 226

CHEM 227 Organic Chemistry Laboratory 2 Credit Hours
Development of the basic laboratory techniques of organic chemistry. The chemistry of functional groups is studied and various organic compounds are synthesized and purified. Eight hours laboratory. (F,W,S).
Prerequisite(s): CHEM 226*

CHEM 228 Org Chem Lab for Chem/Bchm 2 Credit Hours
CHEM 228 incorporates chemical reactions and techniques for the synthesis, purification, and characterization of organic molecules. Students will conduct modern organic chemical experiments, collect data using modern instrumentation, analyze that data, and explain their reasoning in written and visual formats. Students will learn techniques to conduct multi-step synthesis, isolation, and purification of organic molecules and use modern techniques for molecular structure elucidation and to analyze pure samples and mixtures. This course is aimed at students majoring in chemistry or biochemistry. Students cannot receive credit for both CHEM 227 and CHEM 228. (F,W)
Prerequisite(s): ((CHEM 134 and CHEM 136) or (CHEM 144 and CHEM 146)) and CHEM 225 and CHEM 226*
Restriction(s):
Can enroll if Major is Chemistry (ACS Certified), Biochemistry

CHEM 230 Org Chem Lab for Chem/Bchm 2 Credit Hours
CHEM 230 incorporates chemical reactions and techniques for the synthesis, purification, and characterization of organic molecules. Students will conduct modern organic chemical experiments, collect data using modern instrumentation, analyze that data, and explain their reasoning in written and visual formats. Students will learn techniques to conduct multi-step synthesis, isolation, and purification of organic molecules and use modern techniques for molecular structure elucidation and to analyze pure samples and mixtures. This course is aimed at students majoring in chemistry or biochemistry. Students cannot receive credit for both CHEM 227 and CHEM 230. (F,W)
Prerequisite(s): ((CHEM 134 and CHEM 136) or (CHEM 144 and CHEM 146)) and CHEM 225 and CHEM 226*
Restriction(s):
Can enroll if Major is Chemistry (ACS Certified), Biochemistry

CHEM 285 Introduction to Glass Blowing 1 Credit Hour
A study of the nature, properties, and manufacture of glass. Laboratory experience in the manipulation of glass and the construction of scientific apparatus. Discussions, laboratory, and field trips. (AY).

CHEM 303 Inorganic Chemistry I 3 Credit Hours
A study of the chemistry of the elements and their periodic relationship. Bonding theories and structures as well as descriptive chemistry of the representative elements will be emphasized. Three hours lecture. (F).
Prerequisite(s): CHEM 136 or CHEM 146

CHEM 325 Principles of Organic Chem 3 Credit Hours
A one-semester introduction to the compounds of carbon, with an emphasis on structure, preparation, reactivity and characterization of different functional groups. Both aliphatic and aromatic compounds will be examined. The important role of organic compounds in modern society will be highlighted with real world examples including fuels, detergents, plastics, medicines, biomolecules, environmental pollutants and additives. This course may not be used to satisfy the organic chemistry prerequisite for the Biochemistry, Biology, Chemistry, or Microbiology degree programs. Students may not receive credit for both CHEM 225 and 325. CHEM 325 may not be used as a prerequisite for Chemistry 226.
Prerequisite(s): CHEM 124 and (CHEM 136 or CHEM 146)
Restriction(s):
Cannot enroll if Major is Microbiology, Chemistry (ACS Certified), Chemistry (Instructional), Biochemistry, Biological Sciences

CHEM 344 Quantitative Analysis 4 Credit Hours
A survey of theory and practice of volumetric, gravimetric, electrometric and colorimetric analysis. Systematic analysis of complex materials. Two hours lecture, eight hours laboratory. (F).
Prerequisite(s): CHEM 136 or CHEM 146
Corequisite(s): CHEM 344L

CHEM 348 Environmental Chemistry 3 Credit Hours
Description of the concepts, principles, practices, and current problems in the chemistry of natural waters, the soil, and the atmosphere. Three hours lecture. (AY).
Prerequisite(s): CHEM 344 and (CHEM 225 or CHEM 325)

CHEM 349 Environmental Chem Laboratory 1 Credit Hour
Collection and analysis of air, water, soil, and organisms for pollutants such as noxious gases, heavy metals, and trace organics. EPA-approved methods are emphasized. Four hours laboratory. (AY).
Prerequisite(s): CHEM 348* or ESCI 348*

CHEM 352 Introduction to Toxicology 3 Credit Hours
An introduction to the principles of toxicology with an emphasis on environmental toxicology. Major topics include toxic agents, toxicological mechanisms, and use of toxicological reference literature. Discussion of chemical carcinogenesis, genetic toxicology, immunotoxicology, teratology, and toxic responses of the skin, eyes and nervous system. Three hours lecture. (AY).
Prerequisite(s): CHEM 225

CHEM 368 Physical Chemistry I 3 Credit Hours
Nature of the gaseous state, chemical thermodynamics, biochemical and chemical equilibria and kinetics. Three hours lecture, one hour discussion. (W).
Prerequisite(s): CHEM 225 and MATH 115 and (PHYS 125 or PHYS 150)

CHEM 370 Principles of Biochemistry 3 Credit Hours
A concise but comprehensive survey of various areas of biochemistry designed for non-biochemistry majors. The course follows the standard approach to the subject including a description of cells, their structure and constituent macromolecules (proteins, nucleic acids, carbohydrates and lipids), enzymology, bioenergetics, intermediary metabolism and gene regulation. Students cannot take both BCHM 370 and 470 or 471 for any combination of concentration, cognate or minor requirement. Three hours lecture. (F).
Prerequisite(s): BIOL 140 and CHEM 226

CHEM 390 Current Topics in Chemistry 1 to 3 Credit Hours
A course in special topics current to the field of chemistry. Topics and format for the course may vary. See current Schedule of Classes. One to three hours seminar. Permission of instructor. (OC).

CHEM 397 Current Topics in Chemistry 3 Credit Hours
A course for non-science majors which focuses on the interaction of chemistry and society. Sufficient chemical knowledge will be introduced so that the issues can be discussed and competing statements evaluated. Topics covered will include air and water pollution, fuels, designing drugs, etc. (OC).

CHEM 403 Inorganic Chemistry II 3 Credit Hours
A study of coordination and organometallic compounds through the use of current theories. The structure, reactivity, and descriptive chemistry of transition metal complexes will be examined. Three hours lecture. (W).
Prerequisite(s): CHEM 303 and (CHEM 368* or CHEM 468)

CHEM 426 Advanced Organic Chemistry 3 Credit Hours
Spectral analysis, structure determination, reaction mechanisms, synthesis, stereochemistry, and other selected topics are discussed. Three hours lecture. (AY).
Prerequisite(s): CHEM 226 and CHEM 227

CHEM 430 Bioinorganic Chemistry 3 Credit Hours
This course examines the roles that metals play in biological systems, including the chemical principles that make metal ions well-suited for roles in protein structure, in redox catalysis and in acid base chemistry. The physical and experimental techniques that are applied to explore the structure and function of metals in natural systems will be introduced using case studies from the primary scientific literature iin the field. BCHM 370 or its quivalent are strongly recommended but not required.
Prerequisite(s): CHEM 136 and BIOL 140

CHEM 435 Green Chemistry 3 Credit Hours
An examination of green chemistry principles and methods used to assess and improve chemical processes with respect to environmental impact. Topics include: concepts of green chemistry, waste prevention, catalysis, renewable resources, alternative energy resources, and green technologies.
Prerequisite(s): CHEM 226 or CHEM 325
Restriction(s):
Cannot enroll if Class is Graduate

CHEM 436 Polymer Chemistry 3 Credit Hours
The macromolecular concept is introduced and polymerization mechanisms are discussed. The chemistry and physical properties of representative polymeric materials are presented. Topics include the determination and distribution of molecular weights, polymer morphology, mechanical properties of polymers, relaxation phenomena in polymers, and methods of polymer characterization. Three hours lecture. (AY).
Prerequisite(s): CHEM 226 and (CHEM 368* or CHEM 468)

CHEM 437 Nano-Biotechnology 3 Credit Hours
An introduction to the fundamentals of nanotechnology, nano-fabrication processes and its application in different fields with special attention to the life sciences. This course introduces different tools used in nontechnology and investigates how one can borrow the idea of self-assembly from nature to design structures at the nanometer scale. The course also focuses on different contemporary application areas of nanotechnology like biosensor development, cancer research and drug delivery. The research areas of selected companies that are applying nanotechnology to develop new products will also be explored. This course showcases the interchange of ideas between chemistry, materials science and engineering in solving complex biological problems.
Prerequisite(s): (CHEM 136 or CHEM 146) and (PHYS 126 or PHYS 151) and BIOL 140
Restriction(s):
Can enroll if Class is Junior or Senior

CHEM 447 Instrumental Methods of Analys 4 Credit Hours
A study of the theory, operation, and application of instrumental methods of chemical analysis including optical, magnetic, electrochemical, and separation techniques. Two hours lecture, eight hours laboratory. (W).
Prerequisite(s): CHEM 344

CHEM 450 Adv Org Syn & Character Lab 1 Credit Hour
Advanced techniques are applied to synthesis and characterization of organic compounds. Spectroscopic and chromatographic data collection and interpretation are critical to success in the course. Formal writing and data presentation is emphasized. Oral presentation and a poster presentation is required. Crossover experiments with CHEM 452 are likely. Four hours laboratory. This course serves as part of the CACS Capstone experience. (W).
Prerequisite(s): CHEM 227 and CHEM 226 and CHEM 447 and CHEM 468
Corequisite(s): CHEM 452

CHEM 452 Adv Inorg Synth & Char Lab 1 Credit Hour
Advanced techniques are applied to the synthesis and characterization of inorganic compounds. The ability to collect and interpret spectroscopic data is an important aspect of the course. Technical writing and data presentation is emphasized. Oral presentation and a poster presentation is required. Crossover experiments with CHEM 450 are likely. Time is expected outside of the course hours. This course serves as part of the CACS Capstone Experience.Four hours laboratory. (W).
Prerequisite(s): CHEM 226 and CHEM 227 and CHEM 136 and CHEM 403 and CHEM 447 and CHEM 481
Corequisite(s): CHEM 450

CHEM 469 Physical Chemistry II 3 Credit Hours
Nature of the liquid state, simple mixtures, heterogeneous equilibria; quantum theory, atomic and molecular structure, spectroscopy; statistical thermodynamics. Three hours lecture, one hour discussion. (F).
Prerequisite(s): CHEM 368

CHEM 470 Biochemistry I 3 Credit Hours
Life processes from a chemical viewpoint: structure/function relationships of biomolecules, with emphasis on proteins, enzyme kinetics, and mechanisms of action. Three hours lecture. (W).
Prerequisite(s): (BIOL 130 and BIOL 140 and CHEM 134) or (CHEM 144 and CHEM 136) or (CHEM 146 and CHEM 225)

CHEM 471 Biochemistry II 3 Credit Hours
Intermediary metabolism, bioenergetics, energy transformation, metabolic interrelationships, biochemical regulation, highly structured subcellular biochemical systems. Three hours lecture. (W).
Prerequisite(s): BCHM 470 or CHEM 470 or BIOL 470

CHEM 472 Biochemistry Laboratory I 1 Credit Hour
The techniques of preparative and analytical biochemistry. Preparation and characterization of proteins and nucleic acids. Physical and chemical properties of proteins and nucleic acids. Four hours laboratory. CHEM 344 Recommended. (F).
Prerequisite(s): (BIOL 470* or BCHM 470* or CHEM 470*) and CHEM 227

CHEM 473 Biochemistry Laboratory II 1 Credit Hour
The techniques of preparative and analytical biochemistry. Preparation and characterization of lipids and carbohydrates. Methods in metabolism. Four hours laboratory. (W).
Prerequisite(s): (BCHM 471* or BIOL 471* or CHEM 471*) and (BCHM 472* or BIOL 472* or CHEM 472*)

CHEM 481 Physicochemical Measurements 2 Credit Hours
This course requires laboratory work including measurements of properties of pure liquids and solutions, studies of phase equilibria, thermochemical measurements, and analysis of atomic and molecular spectra. Eight hours laboratory. (W).
Prerequisite(s): CHEM 469*

CHEM 490 Topics in Chemistry 1 to 3 Credit Hours
Examination of problems and issues in selected areas of chemistry. Title as listed in Schedule of Classes will change according to content. Course may be repeated for credit when specific topics differ. One to three hours lecture. (YR).
Prerequisite(s): CHEM 226
Restriction(s):
Can enroll if Class is Junior or Senior or Graduate

CHEM 490D Topics in Chemistry 3 Credit Hours
Topic: Bioinorganic Chemistry. Introduces the roles metals play in biological systems. Explores chemical principles that make metals particularly well suited for these roles. Introduces physical and experimental techniques used to explore the structure and function of metals in natural systems. Explores case studies from the literature to synthesize results of various experiments to develop a final understanding of the systems. Students will not receive credit for both CHEM 490D and 590B.
Prerequisite(s): CHEM 226 and BIOL 140

CHEM 493 Chemistry Capstone Portfolio 1 Credit Hour
Employment or graduate studies in chemistry involve integration of experiences and knowledge from one's undergraduate courses. This course is designed to help prepare students for their professional endeavors beyond UM-Dearborn. Students will submit a proposal for a senior project, present the completed project in an appropriate forum, and submit a written report on the project. Students will assemble and present a professional portfolio, and complete an exit interview. The experimental work on the project may be done in an advanced laboratory course or an independent study. (F, W).
Restriction(s):
Can enroll if Class is Senior

CHEM 495 Off-Campus Research Participat 1 to 3 Credit Hours
Participation in ongoing experimental research at an off-campus laboratory. Arrangements made between the research laboratory, the student and the chemistry concentration advisor. No more than six hours combined from CHEM 495, 498, and 499 may be credited toward the 120 hours required for a degree. Four to twelve hours laboratory. Permission of concentration advisor. (F,W,S).

CHEM 497 Seminar in Chemistry 1 Credit Hour
Weekly seminars on topics of current chemical interest presented by faculty members, guest lecturers or students. The subject will vary from term to term. The course may be elected up to three times. One hour seminar. (W).
Restriction(s):
Can enroll if Class is Junior or Senior or Graduate
Cannot enroll if Major is Chemistry (Instructional), Chemistry (ACS Certified)

CHEM 498 Readings in Chemistry 1 to 3 Credit Hours
Library research in a specific area of chemistry performed under the guidance of a faculty member. No more than six hours combined from CHEM 495, 498 and 499 may be credited toward the 120 hours required for a degree. Four to twelve hours of readings. Permission of instructor. (F,W,S).

CHEM 499 Laboratory Research in Chem 1 to 3 Credit Hours
Directed laboratory research performed under the guidance of a faculty member. No more than six hours combined from CHEM 495, 498 and 499 may be credited towards the 120 hours required for a degree. Four to twelve hours laboratory. Permission of instructor. (F,W,S).

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally