

## The A.R. Smith Department of Chemistry (CHE)

*Claudia P. Cartaya-Marin, Chair*

*Eric J. Allain*

*Gregory Anoufrieu*

*Carol M. Babyak*

*Nicole S. Bennett*

*Steven J. Breiner*

*Carol L. Cromwell*

*Cassandra T. Eagle*

*Michael S. Hambourger*

*Grant N. Holder*

*Wendy L. Lewis*

*Jennifer L. Perry*

*Libby G. Puckett*

*Michael B. Ramey*

*Alexander D. Schwab*

*Samuella B. Sigmann*

*Brett F. Taubman*

*Dale E. Wheeler*

*Stephen D. Williams*

*Nancy Wilson*

*Robert J. Yoblinski*

The objectives of the A.R. Smith Department of Chemistry are to prepare students in chemistry for careers in industry, government service, high school and junior college level teaching and for continuing study in chemistry and related areas at the graduate or professional school level. The department also strives to provide a basic understanding of the principles of chemistry and physical science related to all areas of scientific study and to provide the student with an appreciation for the impact of science and technology in today's society.

All majors in chemistry require a minimum of 122 semester hours for the degree. The Bachelor of Arts degree requires a minor. In addition to general education, major and minor requirements, electives must be taken to meet the total required minimum hours. Two semester hours of free electives OUTSIDE the major discipline are required.

**The Bachelor of Arts degree in Chemistry (216A/40.0501)** consists of 32 semester hours above the 1000 level. The required courses are: CHE 2201 and CHE 2203, CHE 2202 and CHE 2204, CHE 2210 and CHE 2211, CHE 3000, CHE 3301, CHE 3302, CHE 3303, CHE 3304, CHE 3404, CHE 3405, CHE 4000, CHE 4400 and five semester hours elected from other chemistry courses. CHE 3520 and CHE 4610 are not accepted. The chemistry major must take PHY 1150-PHY 1151; an additional six to eight hours in either astronomy, geology, biology, or physics (courses at the 1000 level and PHY 3350 are not accepted); and MAT 1110 and MAT 1120. CHE 3560, CHE 3561, Instrumental Methods of Analysis, and CHE 4580, Biochemistry I, are strongly recommended. If CHE 3560, CHE 3561 and CHE 4580 are chosen, this degree is approved by the American Chemical Society's Committee on Professional Training. A candidate for the Bachelor of Arts degree in Chemistry may count no more than a total of 46 semester hours above general education requirements in Chemistry.

The Bachelor of Arts degree as described in the preceding paragraph has been approved by the American Chemical Society's Committee on Professional Training.

**The Bachelor of Science degree in Chemistry (214\*/40.0501)** consists of at least 23 semester hours above the freshman level. The required courses are CHE 2201 and CHE 2203, CHE 2210 and CHE 2211, CHE 3000, CHE 3301, CHE 3303, CHE 3404, and seven hours selected from other chemistry courses. The chemistry major must take PHY 1150-PHY 1151; an additional six to eight hours in either astronomy, biology, geology, or physics (courses at the 1000 level and PHY 3350 are not accepted); and MAT 1110 and MAT 1120.

The student must also select a concentration in a career support area. This concentration must be approved by the department upon entering the Bachelor of Science degree in Chemistry. The concentrations currently available are listed below:

**Certified Chemist concentration (214B).** The required courses, in addition to those listed above, are CHE 2202, CHE 2204, CHE 3302, CHE 3304, CHE 3405, CHE 4000, CHE 4400 or CHE 4510, CHE 3560, CHE 3561 and CHE 4580. CHE 3520 and CHE 4610 are not accepted. A course(s) in computer programming is strongly recommended. This degree has been approved by the American Chemical Society's Committee on Professional Training.

**Environmental concentration (214G).** CHE 2202, CHE 2204 and CHE 3560, CHE 3561 must be selected for the chemistry core and BIO 1110 and GLY 1101 will fulfill the "other sciences" requirement. Other courses required for the concentration are: CHE 4620, BIO 3302, GLY 1103, PHY 3140, STT 2810, ECO 3620, GHY 1010, and PS 2130. The following course is recommended: PS 3280. Recommended electives are PHL 1100, GHY 3100, GHY 3110, GHY 3310, GHY 3320, GHY 3820, GHY 4820, GLY 4630, CHE 3302, CHE 3304, and CS 1440.

**Forensic Science concentration (214H).** The required courses are CHE 2202, CHE 2204, CHE 3560, CHE 3561, CHE 4580, CHE 4581; CJ 1100, CJ 3400, CJ 3405, CJ 3551, CJ 3552; BIO 1110, BIO 3800; and STT 2810.

**Individually Designed concentrations (214F).** Additional concentrations to prepare the chemistry major to pursue other career opportunities may be developed in consultation with the chair of the Department of Chemistry and must be individually approved.

**Marketing and Business concentration (214D).** Additional required chemistry courses are: CHE 2202 and CHE 2204. Required marketing and business courses: ACC 2100, ECO 2030, MKT 3050, MKT 3220, MKT 3230, MKT 3900. Recommended electives: ACC 2110, ECO 2040, ECO 2100, LAW 2150, MKT 4620. Completing the required marketing courses listed above with an overall GPA of at least 2.00 qualifies a student to minor in Marketing.

**Preprofessional and Paramedical concentration (214E).** CHE 2202 and CHE 2204, and CHE 4580 must be selected. The required biology courses are: BIO 1110, BIO 2001, BIO 3301, BIO 3306, BIO 3307, BIO 3308, and BIO 3309; BIO 3314 and BIO 3800 are recommended. (Appropriate substitutions may be made with the approval of the departmental chair.)

**The Bachelor of Science degree in Chemistry, Secondary Education (215A/13.1323)[T] with teacher licensure** consists of at least 24 semester hours above the freshman level. The required courses are either CHE 2101 and CHE 2203; or CHE 2201 and CHE 2203, and CHE 2202 and CHE 2204; CHE 2210 and CHE 2211, CHE 3000, CHE 3301, CHE 3303, CHE 3404, CHE 3521, and additional hours selected from other chemistry courses to make a total of at least 24 semester hours. CHE 4580, Biochemistry I, is recommended. Experience as a tutor through the Learning Assistance Program or the Supplemental Instruction Program is strongly recommended. The chemistry major must take PHY 1150-PHY 1151; BIO 1110 and GLY 1101; MAT 1110 and MAT 1120; and GS 4403 and RE 4630 (minimum grade of "C" required in GS 4403 and RE 4630). This program also provides an endorsement in physical science. In order to obtain a secondary science endorsement, a total of at least twelve semester hours must be taken in either biology or geology or physics. Each additional science endorsement requires at least twelve semester hours of coursework in a specific science area. For information on the professional education requirements for secondary education licensure, see the Department of Curriculum and Instruction.

All junior and senior students majoring in chemistry are expected to participate in weekly seminar discussion periods each semester in residence.

**A minor in Chemistry (214/40.0501)** consists of at least 20 semester hours: CHE 1101, CHE 1110 and CHE 1102, CHE 1120 (or equivalent) and twelve to fourteen semester hours of chemistry in two or more areas of chemistry from the following: analytical, biochemistry, inorganic, organic, and physical. The twelve to fourteen hours must include laboratory experiences in at least two different areas.

### Honors Program in Chemistry

The A.R. Smith Department of Chemistry offers an honors program in chemistry. Admissions to the honors program requires completion of CHE 1101 and CHE 1102 (Introductory Chemistry I and II), CHE 2201 (Organic Chemistry I) or CHE 2101 (Fundamentals of Organic Chemistry) and a minimum grade-point average, both overall and in the major, of 3.20. To graduate with "honors in chemistry," a student must have a minimum grade point average of 3.45, overall and in chemistry, and must take nine semester hours of chemistry honors credits with a "B" average or better, including CHE 4000 (Chemistry Seminar with honors) and CHE 4510 (Chemistry Honors Thesis). Students may arrange to take specific chemistry courses on an honors basis by negotiating an honors contract with the course instructor before class begins. The honors contract, which was developed by the Department of Chemistry Honors Committee, allows the student to receive honors credit for a regular course in chemistry by specifying the additional assignments that the student should perform in order to receive honors credit. The departmental honors committee must approve the honors contract.

### The Bachelor of Science degree in Environmental Science (121A/03.0104)

In addition to the the discipline-specific degrees offered by the department, an interdisciplinary Bachelor of Science degree in Environmental Science provides a broad and rigorous curriculum in the natural sciences. Students completing this degree will be prepared to enter environmental science positions in industry, business, or government as well as pursue post-graduate studies in various areas of environmental science.

The Bachelor of Science degree in Environmental Science (121A/03.0104) consists of 123 semester hours including 44 semester hours of general education requirements. Seventy-four semester hours in the major and cognate disciplines are required, which includes the following: the science core (BIO 1110, BIO 2000 or BIO 2001, GLY 1101, GLY 2250, PHY 1150, PHY 1151, CHE 1101 and CHE 1110, CHE 1102 and CHE 1120, CHE 2101 and CHE 2203, MAT 1110, MAT 1120, and STT 2810); completion of BIO 3302, CHE 2550, GLY 4630, PHY 3140, GHY 3820, and PLN 4460; completion of 12 semester hours from at least two of the following categories: a) Chemistry (CHE 2210, CHE 2211, CHE 3301, CHE 3303, CHE 3560, CHE 3561, and CHE 4620), b) Geophysical Sciences (GHY 3310, GLY 3150, GLY 3333, GLY 3530-3549, GLY 3800, GLY 4705, GLY 3160 or PHY 3160, PHY 3150, PHY 3230, PHY 3850, PHY 3851, PHY 4020, PHY 4330, PHY 4730), or c) Biology (BIO 3304, BIO 3310, BIO 3320, BIO 3530-3549, BIO 4555, BIO 4571, and up to two organismal biology courses from the following list: BIO 4551, BIO 4552, BIO 4556, BIO 4557, BIO 4558, BIO 4559, BIO 4560, BIO 4567); three semester hours of science electives; and the environmental science capstone course, ENV 4100.

## Courses of Instruction in Chemistry and Environmental Science (GSC, CHE, ENV)

This catalog reflects fall and spring semester offerings. Go to [www.summerschool.appstate.edu](http://www.summerschool.appstate.edu) for courses offered in summer terms. (For an explanation of the prefixes used in the following courses, see the listing of [Course Prefixes](#).)

### GENERAL SCIENCE CHEMISTRY (GSC)

#### **GSC 1020. Contemporary Chemistry** (2).F;S.

*GEN ED: Science Inquiry Perspective (Theme: "Contemporary Science")*

A course in a sequential series of four science mini-courses. (EACH MINI-COURSE LASTS FOR ONE-HALF SEMESTER. STUDENTS SHOULD BE ADVISED TO REGISTER FOR TWO MINI-COURSES IN ONE SEMESTER TO TOTAL FOUR SEMESTER HOURS.) The course will introduce students to selected fundamental principles and concepts of chemistry discussed and developed in the context of science topics of concern or interest in modern society. Co- or prerequisite: college-level mathematics course. Corequisite: GSP 1010. Contemporary Physics or GSA 1010. Contemporary Astronomy. Lecture three hours, laboratory two hours. This course will not satisfy program requirements for students majoring in biology, chemistry, computer science, geology, or physics. (NUMERICAL DATA) (CORE: NATURAL SCIENCES) (ND Prerequisite: passing the math placement test or successful completion of MAT 0010.)

### CHEMISTRY (CHE)

#### **CHE 1101. Introductory Chemistry I** (3).F;S.

*GEN ED: Science Inquiry Perspective (Theme: "Chemistry: Connections to Our Changing World")*

A study of the fundamental principles of chemistry emphasizing modern atomic theory, the structure and behavior of atoms, the properties and states of matter, energy relations, periodicity and mole concepts. Lecture three hours. Corequisite or prerequisite: CHE 1110. (NUMERICAL DATA) (CORE: NATURAL SCIENCES) (ND Prerequisite: passing the math placement test or successful completion of MAT 0010.)

#### **CHE 1102. Introductory Chemistry II** (3).F;S.

*GEN ED: Science Inquiry Perspective (Theme: "Chemistry: Connections to Our Changing World")*

A study of properties of solutions, acid-base concepts, equilibria, elementary thermodynamics, elementary kinetics, electrochemistry. Lecture three hours. Prerequisites: CHE 1101 and CHE 1110; corequisite or prerequisite: CHE 1120. (NUMERICAL DATA) (CORE: NATURAL SCIENCES) (ND Prerequisite: passing the math placement test or successful completion of MAT 0010.)

#### **CHE 1110. Introductory Chemistry Laboratory I** (1).F;S.

*GEN ED: Science Inquiry Perspective (Theme: "Chemistry: Connections to Our Changing World")*

Laboratory experiments to supplement the study of the topics listed under CHE 1101. Laboratory three hours. Corequisite or prerequisite: CHE 1101. (CORE: NATURAL SCIENCES)

#### **CHE 1120. Introductory Chemistry Laboratory II** (1).F;S.

*GEN ED: Science Inquiry Perspective (Theme: "Chemistry: Connections to Our Changing World")*

Laboratory experiments to supplement the study of the topics listed under CHE 1102. Laboratory three hours. Corequisite or prerequisite: CHE 1102. (CORE: NATURAL SCIENCES)

#### **CHE 2101. Fundamentals of Organic Chemistry** (3).F;S.

A study of the fundamental concepts and basic physical and chemical properties of the major classes of the compounds of carbon. Emphasis is placed upon the importance of these groups in living systems and in everyday life. Lecture three hours. Prerequisites: CHE 1102 and CHE 1120; prerequisite or corequisite: CHE 2203. This course is not an appropriate prerequisite for CHE 2202.

#### **CHE 2201. Organic Chemistry I** (3).F;S.

First course of a two-semester sequence in organic chemistry. An in-depth study of structure, bonding, properties and stereochemistry of carbon compounds. Introduction to classes of organic compounds and their nomenclature, reaction mechanisms and organic synthesis will also be introduced. Lecture three hours. Prerequisites: CHE 1102 and CHE 1120; prerequisite or corequisite: CHE 2203.

#### **CHE 2202. Organic Chemistry II** (3).F;S.

Second course of a two-semester sequence in organic chemistry. Continuing coverage of the classes of organic compounds. Detailed coverage of spectroscopy, carbonyl compounds (aldehydes, ketones, carboxylic acids and derivatives), and amines. Amino acids, carbohydrates and proteins will also be introduced. Reaction mechanisms, organic synthesis and spectroscopy will be emphasized. Lecture three hours. Prerequisites: CHE 2201 and CHE 2203 (with a minimum grade of "C-" in each). Corequisite or prerequisite: CHE 2204.

**CHE 2203. Organic Chemistry Laboratory I (1).F;S.**

Laboratory practice in the synthesis of organic compounds and the use of common laboratory techniques. Laboratory three hours. Prerequisites: CHE 1102, CHE 1120; corequisite or prerequisite: CHE 2101 or CHE 2201.

**CHE 2204. Organic Chemistry Laboratory II (1).F;S.**

Laboratory practice in synthesis, separations, practical spectroscopy, and determination of unknowns. Laboratory three hours. Prerequisites: CHE 2201 and CHE 2203 (with a minimum grade of "C-" in each). Corequisite or prerequisite: CHE 2202. (WRITING)

**CHE 2210. Quantitative Analysis (2).F;S.**

An introduction to analytical chemistry, including a rigorous examination of facets of homogeneous and heterogeneous equilibrium; electrochemical, spectrophotometric, gravimetric, and chromatographic analysis; and evaluation of data. Lecture two hours. Prerequisites: CHE 1102 and CHE 1120. Corequisite or prerequisite: CHE 2211.

**CHE 2211. Quantitative Analysis Laboratory (2).F;S.**

An introduction to analytical chemistry techniques of volumetric, gravimetric, potentiometric, chromatographic, and spectroscopic analysis. The basic methods of quantitative analysis are introduced and practiced with laboratory unknowns. Laboratory six hours. Corequisite or prerequisite: CHE 2210. (WRITING)

**CHE 2400. Introduction to Forensic Chemistry and Criminalistics (3).F.**

Introduction to forensic chemistry, including utilization of physical evidence in law enforcement, processing a crime scene, the application of chemistry techniques in the identification and analysis of physical evidence (drugs, blood, fire residues, glass, soil, ink, etc.), forensic toxicology, forensic microscopy, and forensic aspects of arson. Techniques such as chromatography, ultraviolet-visible and infrared spectroscopy, refractive index measurements, breath-analyzers, DNA fingerprinting, and blood-typing will be discussed. Prerequisites: CHE 1102 and CHE 1120. (CROSS-DISCIPLINARY)

**CHE 2500. Independent Study (1-4).F;S.**

**CHE 2530–2549. Selected Topics (1-4).** On Demand.

**CHE 2550. Introduction to Environmental Chemistry (3).F.**

An introduction to environmental issues as seen through a chemical perspective. A broad survey of the biosphere, hydrosphere, lithosphere, atmosphere, and energy will be conducted. Specific topics include toxic organic compounds, pesticides, environmental endocrine disruptors, metal pollution, natural water chemistry, water pollution and purification, soil chemistry, soil contamination and remediation, the ozone hole, smog, global warming, alternative fuels, and renewable energy. A combination of lecture and lab which meets once per week for three hours. Prerequisites: CHE 1101 and CHE 1110. (CROSS-DISCIPLINARY)

**CHE 3000. Introduction to Chemical Research (1).F;S.**

An introduction to the techniques and methodology of chemical research. Topics include survey of the chemical literature; information retrieval services; making effective oral presentations, and ethics and safety in the chemical laboratory. This course requires formal speaking. Prerequisites: CHE 2101 or CHE 2202 and CHE 2210. (SPEAKING)

**CHE 3301–3302. Physical Chemistry I–II (3-3).F-S.**

Physical Chemistry is built upon four major theoretical principles; thermodynamics, kinetics, quantum mechanics, and statistical mechanics. Physical Chemistry I covers an introduction to thermodynamics and kinetics. Physical Chemistry II covers an introduction to quantum mechanics and statistical mechanics. Prerequisites: CHE 2210, MAT 1120, and a year of physics. Lecture three hours. (COMPUTER)

**CHE 3303-3304. Physical Chemistry Laboratory (1-1).F-S.**

*GEN ED: Junior Writing (CHE 3303)*

Experimental investigations which supplement the study of the topics in physical chemistry. Applications of computer techniques for data reduction and manipulation will be introduced and utilized. CHE 3301 is corequisite or prerequisite for CHE 3303 and CHE 3302 is corequisite or prerequisite for CHE 3304. (WRITING)

**CHE 3404. Inorganic Chemistry (3).S.**

The fundamentals of atomic theory and valence bond, ligand field and molecular orbital theories for interpretation of chemical bonding are considered in detail. Applications of these theories to the magnetic and spectral properties, structure, stability, and reaction mechanisms of inorganic compounds are examined, with emphasis on the transition metals. Symmetry and group theory are used to describe the fundamentals of X-ray crystallography. The role of metal atoms in organometallic and bioinorganic molecular systems is considered. Prerequisite: CHE 3301. Lecture three hours.

**CHE 3405. Inorganic Chemistry Laboratory (1).S.**

Experimental investigations which supplement the study of inorganic chemistry, involving reactions in inert atmospheres, vacuum systems and hot tubes. Corequisite or prerequisite: CHE 3404. Laboratory three hours.

**CHE 3500. Independent Study (1-4).F;S.****CHE 3520. Instructional Assistance (1).F;S.**

A supervised experience in the instructional process at the University level through direct participation in a classroom situation. Graded on an S/U basis. Prerequisite: junior or senior standing. May be repeated for a total credit of three semester hours.

**CHE 3521. Secondary Science Field Experience (1).F;S.**

A supervised experience in the instructional process at the secondary school level through direct participation in a classroom situation. Graded on an S/U basis. Prerequisite: junior or senior standing. May be repeated for a total credit of three semester hours. Required of all teacher-licensure candidates in chemistry.

**CHE 3530-3549. Selected Topics (1-4). On Demand.****CHE 3560. Instrumental Methods of Analysis (3).S.**

A study of some of the modern instrumental methods of analysis including electrochemistry, atomic and molecular spectroscopy, magnetic resonance spectrometry, mass spectrometry and gas chromatography. Lecture three hours. Prerequisite: CHE 3301. Corequisite or prerequisite: CHE 3561.

**CHE 3561. Instrumental Methods of Analysis Laboratory (1).S.**

Experimental investigations involving spectroscopic, electrochemical, and chromatographic measurements to enhance the understanding of sampling, sample preparation, data reduction, use of analytical instrumentation and data interpretation. Computational techniques for data reduction and modeling will be required. Laboratory three hours. Corequisite or prerequisite: CHE 3560. (WRITING)

**CHE 4000. Chemistry Seminar (1).F;S. (EFFECTIVE: SPRING, 2010)**

*GEN ED (EFFECTIVE: SPRING, 2010): Capstone Experience*

A senior capstone experience on the presentation and discussion of current chemical topics. Oral and written reports are required. Prerequisites: CHE 3000 and CHE 3303. (SPEAKING)

**CHE 4400. Senior Research (1).F;S.**

A laboratory research project under the supervision of a faculty member. An oral report of the work in progress will be made at the regular seminar and a written report of the results is to be submitted to the chemistry faculty upon completion. Laboratory four hours (minimum). Prerequisites: CHE 3405 and CHE 4000 or permission of the instructor. May be repeated once for credit. (SPEAKING)

**CHE 4510. Chemistry Honors Thesis (1).F;S.**

Independent study and research for an honors thesis directed by a faculty member of the A.R. Smith Department of Chemistry. Prerequisite: completion of seven honors credit hours in chemistry (including CHE 4000 with honors) and a minimum grade point average of 3.45 overall and in chemistry. All honors students must earn credit in this course in two different semesters. To complete the honors thesis requirements, a written thesis must be submitted to and approved by the Department of Chemistry Honors Committee.

**CHE 4580. Biochemistry I (3).F;S.**

This course covers the properties of amino acids, proteins, carbohydrates, lipids and nucleic acids and presents a brief introduction to enzymology. Major emphasis is on the chemistry of biological compounds. An introduction to intermediary metabolism is also presented. Prerequisite: CHE 2101 or CHE 2202. Lecture three hours. [Dual-listed with CHE 5580.]

**CHE 4581. Biochemistry I Laboratory (1).F;S.**

Experimental investigations which supplement the study of the topics in biochemistry. Prerequisite: CHE 2203 (or equivalent); co- or prerequisite: CHE 4580 or CHE 5580 (or equivalent). Laboratory three hours. (WRITING) [Dual-listed with CHE 5581.]

**CHE 4582. Biochemistry II (3).S.**

This course will cover the intermediary metabolism of amino acids, nucleic acids, carbohydrates and lipids. Metabolic pathways and their associated enzymes are emphasized. Prerequisite: CHE 4580 with CHE 3301 recommended but not required. Lecture three hours. [Dual-listed with CHE 5582.]

**CHE 4590. Spectral Interpretations (2).F.**

A study of the use of spectral data for the identification of organic compounds. Techniques will include UV, IR, NMR, MS, ORD and CD in the identification process. Prerequisites: CHE 2202 and CHE 2204. Lecture two hours.

**CHE 4595. NMR Spectroscopy (2).S.**

The lecture portion of the course will cover basic nuclear magnetic resonance spectroscopy theory and practice, with particular attention given to the instrumentation available in the department. The laboratory portion of the course will focus on learning to utilize the NMR instrumentation available in the department. Prerequisite: CHE 4560 or CHE 4590. Lecture one hour, laboratory three hours.

**CHE 4600. Selected Topics (1-4). On Demand.**

An opportunity to study a special topic or combination of topics not otherwise provided for in the chemistry curriculum. May be repeated for credit when content does not duplicate. Prerequisite: upper-division status or departmental permission.

**CHE 4610. History of Chemistry (3).S.**

A study of the development of chemistry as a science with emphasis on the development of basic concepts, ideas and theories. Prerequisite: a year of introductory chemistry. Lecture three hours.

**CHE 4620. Environmental Chemistry (4).S.**

*GEN ED: Capstone Experience*

A capstone course for students pursuing a concentration in Environmental Chemistry, this course will focus the wide diversity of subject matter required by this major. The course will involve discussions and applications of air, water and soil chemistry while giving the student an appreciation of the scientific, legal, political and economic issues inherent in Environmental Chemistry. Prerequisites: CHE 3301, CHE 4560, STT 2810. Lecture three hours, laboratory three hours.

**CHE 4900. Internship in Chemistry (1-12).F;S. (EFFECTIVE: SPRING, 2010)**

*GEN ED (EFFECTIVE: SPRING, 2010): Capstone Experience*

Independent, supervised work in applied chemistry at an approved industrial, quality control, analysis, or production facility. Appropriate entities include, but are not limited to, commercial businesses and governmental agencies. May be taken for a maximum of 12 semester hours, with a maximum of 6 semester hours credit per summer session. Only three of those hours will count toward major requirements. Graded on an S/U basis. Prerequisite: CHE 3303.

**ENVIRONMENTAL SCIENCE (ENV)**

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**ENV 4100. Environmental Science Seminar (3).S.**

*GEN ED: Capstone Experience*

This course emphasizes the critical need for a multi-disciplinary and cooperative approach to solving challenging environmental issues on local and global scales. The course is project-driven and employs literature and case study research, data gathering, and active group problem-solving to address issues such as scientific and engineering solutions, environmental and economic impacts, regulatory compliance, and public policy. Students are required to disseminate project results via written reports, oral presentations, and/or poster sessions. This course serves as the senior capstone course for students enrolled in the Bachelor of Science degree in Environmental Science. Lecture two hours, laboratory three hours. Prerequisite: senior standing or permission of the instructor.