Mission Statement

Bachelor of Science in Chemistry, Environmental Chemistry Option

(Program Code: BS-CEC)

Chemistry is an experimental science. The predictive capability and therefore the utility of chemistry is based upon an enormous body of observations and deductions. The science of chemistry represents a comprehensive model for the nature and behavior of macroscopic chemical, physical, and biological systems that can be explained by microscopic atomic and molecular structure and interactions. Fundamental chemical concepts are formulated in pure mathematics and physics, but these concepts must survive tests of quantitative measurement. Application of chemical knowledge is frequently a province of high specialization, of technological sophistication, and of healthy scientific contention regarding new interpretations and observations. However, chemists involved in either applied chemistry or in research and development in all areas share an extensive core set of skills, standardized terminology, and a body of experimentally confirmed factual knowledge. The curriculum of the baccalaureate degree programs of the Department of Chemistry at the University of Nevada, Reno provides students with both a broad liberal arts background and the specialized knowledge and skills in Chemistry needed to embark on a career as a chemist in the public or private sectors, to continue in graduate studies in chemistry, to pursue one of the medical professions, or to become an educator. Chemistry majors will graduate with a comprehensive set of knowledge and skills in the disciplines of chemistry, including organic, inorganic, physical, and analytical chemistry, and with basic knowledge and skills in physics and mathematics. A core set of chemistry courses provides fundamental knowledge and experimental training in the various disciplines. These are augmented by advanced courses suitable for preparation for graduate study or for specialization in environmental chemistry. The experimental nature of the science of chemistry is emphasized in laboratory experiences. Training in operational skills—how to do chemistry—is provided in laboratory courses at every level of instruction. Skills in scientific communication, chemical information retrieval, and modern computation are also incorporated at all stages. The opportunity for involvement in undergraduate research allows exposure to the frontiers of chemistry research and close interaction with a faculty member. The Bachelor of Science in Chemistry degree with the Environmental Chemistry Option provides rigorous training in experimental and theoretical chemistry, and includes undergraduate environmental chemistry research and specialized courses in environmental sciences. The environmental chemistry option is recommended for students interested in employment as an environmental chemist or for preparation for graduate study in environmental science. This program has been approved by the American Chemical Society (ACS) as satisfying rigorous national standards, and also satisfies the extra ACS requirements for environmental chemistry.

Student Learning Outcomes

Outcome 1: Chemical knowledge

- (a) Graduates will possess a broad spectrum of factual chemical knowledge concerning naming and chemical and physical properties of substances.
- (b) Graduates will possess a thorough knowledge of basic principles of chemistry, including atomic and molecular structure, chemical reactions and stoichiometry, and the chemical and physical properties of substances.
- (c) Graduates will possess a thorough knowledge of the subfields of chemistry, including analytical, inorganic, organic, and physical chemistry.
- (d) Graduates will possess cognitive skills in areas such as mathematics and physics to facilitate the understanding and manipulation of fundamental chemical
Student Performance Indicators

- ACS standardized exam in General Chemistry
- ACS standardized exam in Organic Chemistry
- ACS standardized exams in Physical Chemistry
- ACS standardized exam in Inorganic Chemistry
- Student tracking/performance data in CHEM 201, 341, 421, 431.

Assessment Method

- Exam administered at the beginning of CHEM 347 (first semester organic chemistry laboratory). Results compared to national norms and correlated with individual student grades in CHEM 201 & 202 (General Chemistry for Scientists and Engineers I & II). Exam not used for lab course grade.
- Exam administered at the end of CHEM 348 (second semester organic chemistry laboratory). Results compared to national norms and correlated with individual student grades in CHEM 341 & 342 (Organic Chemistry for Scientists and Professionals I & II). Exam not used for lab course grade.
- Thermodynamics and quantum chemistry parts of the exam administered in CHEM 421 & 422 (Physical Chemistry I & II), respectively. Results compared to national norms and correlated with individual student grades. Use of exam scores in grading is at the discretion of the instructor, but exams do not substitute for the course final exams.
- Exam administered in CHEM 431 (Inorganic Chemistry). Results compared to national norms and correlated with individual student grades. Use of exam scores in grading is at the discretion of the instructor, but the exam does not substitute for the course final exam.
- Analysis of student tracking data, how students perform (grades and ACS exam scores) in each course relative to their ACT/SAT test scores and correlated with grades in prerequisite courses, broken down by previous instructor or institution in the case of transfer students.
Outcome 2: Quantitative reasoning skills

- (a) Graduates will possess an understanding of and the ability to apply the scientific method (formulating hypotheses and arriving at logically supported answers and conclusions).
- (b) Graduates will have a practical understanding of applied mathematics, including algebra, geometry, differential and integral calculus, and topics in differential equations, matrix theory, and probability theory.
- (c) Graduates will possess the ability to competently solve problems including the concepts of extrapolation, approximation, precision, accuracy, rational estimation, and statistical validity.
- (d) Graduates will possess the ability to evaluate and interpret chemical, numerical, and general scientific information.

Student Performance Indicators

- Final exams in CHEM 201 & 202, 330, 341 & 342; 421 & 422, 435; 442, 450.
- Problem sets in advanced courses CHEM 431, 442, 450.
- Student tracking/performance data in CHEM 431, 442, 450.

Assessment Method

- Exams from all instructors reviewed on the five-year cycle for problem-solving and quantitative difficulty according to a rubric that emphasizes various reasoning, problem-solving, and mathematical skill (rather than knowledge or content areas).
- A representative portfolio of problem sets from students in each course reviewed on five-year cycle according to a rubric (as above).
- Analysis of student tracking data, how students perform (grades and final exam scores) in each course relative to their ACT/SAT test scores and correlated with grades in prerequisite courses, broken down by previous instructor or institution in the case of transfer students.

Outcome 3: Experimental skills

- (a) Graduates will possess the ability to perform accurate quantitative measurements, interpret experimental results, perform calculations on these results and draw appropriate and accurate conclusions.
- (b) Graduates will possess the ability to synthesize, separate, and characterize compounds using published methods, safe laboratory protocols, standard laboratory equipment, and modern instrumentation.
- (c) Graduates will possess an understanding of the theory and use of modern chemical instrumentation.
- (d) Graduates will be able to design and perform effective laboratory experiments, to gather and analyze data, and to test hypotheses.
### Student Performance Indicators
- Safety performance
- Laboratory skills
- Safety training completion (in lab courses and EH&S safety course for undergraduate research students)

### Assessment Method
- Official accident reports for courses and undergraduate research reviewed annually by departmental Safety Committee in consultation with EH&S. Safety enhancements recommended to Director of Laboratories and lab course instructors.
- Student performance on a selected experiment in a selected experiment in senior-level lab courses (CHEM 432, 435, 444, 455) scored annually by lab instructor according to rubric that emphasizes independent laboratory skills. [Rubric to be developed for implementation in 2003-4].
- Required for each lab course and for Senior Thesis. Exit interview question on effectiveness of safety training.

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### Outcome 4: Communication and information skills

- (a) Graduates will be proficient in the oral and written communication of their scientific work and ideas.
- (b) Graduates will possess the ability to make effective use of information resources, including (i) finding chemical information utilizing the primary literature, both in a traditional library and in electronic indexes and journals, (ii) critically evaluating chemical information, (iii) finding and evaluating chemical information utilizing secondary sources such as electronic databases.
- (c) Graduates will be proficient in the use of computers, modern computer software, and computer-based information systems, including (i) using a computer as a tool in technical writing, drawing chemical structures, and presenting data to effectively communicate scientific information, (ii) having a familiarity with the application of computational chemistry in the modeling and simulation of chemical phenomena, and (iii) having an appreciation of the applications of computers in data acquisition and processing.

### Student Performance Indicators
- Unknowns laboratory report in CHEM 348.
- CHEM 423 Physical Chemistry Laboratory long reports.
- Senior Thesis

### Assessment Method
- Scored using a rubric for written scientific reports.
- Scored using a rubric for written scientific reports. Compared with previous rubric score in CHEM 348 for individual students.
- Scored using a rubric for written scientific reports. Compared with previous rubric scores in CHEM 348 and 423 for individual students. Copies
of all senior theses are filed by the department office.

Outcome 5: Professional and career success

- (a) Graduates will be successful in their professional careers as demonstrated by their abilities to solve important chemistry problems, to solve problems in areas different from their training, and to develop new and valuable ideas.
- (b) Graduates will be able to work in a variety of professional environments as demonstrated by the abilities to work both in teams and independently, to provide project leadership, to mentor junior co-workers, and to communicate scientific results effectively to the chemistry community and the public.
- (c) Graduates will possess professional character as demonstrated by their ethical behavior, their pursuit of continuing education and involvement in professional associations, and their commitment to safety and protection of the environment.

Student Performance Indicators

- Graduate and professional schools test scores
- Post-graduation employment or graduate school placement
- Career employment and salary data
- Job performance

Assessment Method

- GRE and MCAT exam scores (exit interview question).
- Exit interview, compared with national trends.
- Alumni survey. Data compared with annual ACS salary survey of all chemists, by employment type.
- Alumni Employer Survey.

Use of Results

The departmental Undergraduate Study Committee will collect and review data from all assessment activities and will prepare the annual assessment report. The report will review general progress for each Learning Outcome area and will make recommendations for changes to courses or major requirements. The annual report will also evaluate the effectiveness of each assessment activity and recommend appropriate improvements.

Implementation Plan

The departmental Curriculum and Assessment Committee is responsible for overall implementation of the Assessment Plan. The committee is charged with developing and implementing the rubrics for evaluation of final exams, problem sets, written reports, and laboratory skills. The committee coordinates data collection, but individual faculty are responsible for administering assessment activities in specified courses and for providing the results to the Curriculum and Assessment Committee. The departmental Safety Committee is responsible for the safety assessments. The assessment data collection activities for required majors courses are conducted each time the course is offered.

For comprehensive reviews of course content and difficulty, a five-year cycle will be used with courses divided into the following areas:

1. general chemistry and analytical chemistry [CHEM 201, 202, 330, 455],
2. organic chemistry [CHEM 341, 342, 347, 348, 442, 443, 444, 449],
3. physical and biophysical chemistry CHEM 421, 422, 423, 450, 451],
4. inorganic chemistry and undergraduate research [CHEM 431, 432, 435, 495, 496], and
5. service courses for non-majors [CHEM 100, 121, 122, 220, 220L, 241, 242, 345, 425].

In this manner, each area of the curriculum will have been reviewed before the five-year re-approval of the program certification by the American Chemical Society. The chair of the Curriculum and Assessment Committee coordinates the comprehensive reviews with the divisional faculty liaisons for the inorganic, organic, and physical chemistry course areas, or with appropriate lecturers and faculty for the general course areas.

The five-year reviews will include a comprehensive written analysis of the courses. The review will include in its analysis the assessment data collected in prior years and information from regular student evaluations of the courses. The comprehensive reviews will analyze both the individual courses and how they fit together in the overall majors curriculum. It is expected that each comprehensive review will result in recommendations for improvements in the courses and possibly for changes in the courses, course descriptions, or course prerequisites.

The annual Assessment Report will include a summary of the comprehensive review done that year. The annual assessment report will be prepared in the early Fall semester based on data collected the previous academic year, and is expected to be presented to the faculty at the October department faculty meeting. Required course or requirement changes will be submitted in time for the following year’s General Catalog.