Core Curriculum Course Submission
Criteria: Science

1. General Information

a. Originating Person	b. Contact Person's E-mail	c. Contact Phone	d. Date
Jeffrey Gaffney	jsgaffney@ualr.edu	(501)569-8840	04/15/2014

e. College/School	f. Department/Program
College of Arts, Letters, & Sciences	Chemistry

☒ **Submission Statement**
By submitting this form, we acknowledge our understanding that the Core Council has the authority to review approved courses to ensure they continue to meet the established goals and outcomes of that category of the core; that the Council has authority to develop a core assessment program; and that the Council will be developing review and assessment policies by the end of 2014. Further, we agree that if this course is approved, we will participate in the university-wide assessment of the core.

☒ **Chair and Dean Awareness**
Your department chairperson and college dean must be made aware of your submission for core. By submitting this form, you are acknowledging that this has occurred.

2. Course Information

a. Course ID	b. Current Title
CHEM 1406	Chemistry for Engineers

c. Catalog Description

This course is designed for Engineering Students. This one semester chemistry course will give engineering students key concepts and principles in chemistry needed for their basic background knowledge. This course is presented using engineering relevant examples and stresses applications in engineering and technology. Note: Course Requirements. Consent of Instructor is required. This course has a prerequisite of 70 or higher score on a department placement test. Students who do not attain the minimum score may enroll in CHEM 1300. MATH 1311 Applied Calculus I, or MATH 1342 Business Calculus, or MATH 1451 Calculus I are prerequisite concurrent. Students completing 1406 and changing majors to chemistry may substitute CHEM 1406 for CHEM 1402. Students may not receive credit for both 1402 and 1403 by completing 1406. Three hour-lectures and one-three hour laboratory session per week. Four credit hours.

d. How will your department ensure a level of consistency among sections of this course? Who will be responsible for this?

This laboratory science course will use a common syllabus for all instructors that will be reviewed by the department's curriculum committee each semester that this course is taught. Any new instructors for this core course will be given a copy of the grid outline submitted to the core council with instructions to make sure that they include it in ther course planning. Currently this class is not offered online. As a chemistry laboratory course the department does not plan on offering this class online. Any new faculty teaching this class will be mentored and will use the standard syllabus. Any changes to the syllabus will be reviewed by the chair and department curriculum committee. This course requires a pre-test for entrance into the course to insure that the students have the proper preparation to succeed in CHEM 1406.

Educational Goals	Learning Outcomes students will...	Learning Objectives: At the end of the course students will be able to...	Assignments	Explanation
Knowledge 1 – Concepts, methodologies, findings, and applications of mathematics and the social and natural sciences, engineering and technology.	1. understand the theoretical perspective used in one or more science discipline;	**Learning Objectives 1.1** identify key concepts and principles in chemistry needed for their basic background knowledge. This includes basic theory involved in chemical bonding, structure, reactions and thermodynamics.	**Assignments 1.1** Reading assignments from the textbook include doing homework problems at the end of each chapter. Student understanding and mastery of these concepts is assessed using quizzes. Laboratory experiments are designed to emphasize practical aspects as well as to reinforce theoretical topics covered in the lecture.	**Explanation 1.1** The Accreditation Board for Engineering and Technology (ABET) is the accrediting vehicle for the UALR Engineering programs. This class was developed and continues to work to insure that ABET outcomes in chemical education for engineers is accomplished. The lecture and book chosen for the course makes use of engineering examples to develop these skills.
	2. understand observational and experimental methods used in one or more of the sciences;	**Learning Objectives 1.2** Employ observational and experimental methods used in chemistry with emphasis on standard safety methods to insure safe handling of chemicals and other materials.	**Assignments 1.2** Laboratory experiments (eleven) cover a wide variety of chemical concepts and stresses the importance of safety. Students develop an understanding of basic chemical methods including determining acidity of reactions, measuring gas evolution, performing both qualitative and quantitative determinations of chemical reactions, and using simple instrumentation and spectroscopy to determine rates of chemical reactions. Students are required to do pre-lab written assignments, and keep a copy of their data in lab notebooks. These	**Explanation 1.2** Lectures and laboratory assignments are coordinated to stress specific chemical principles and reactions concepts. During both lab and lecture the reactions chosen stress the relationships between these concepts and engineering. Some examples include the relationship between materials and reactions, such as corrosion, and reactions that occur as a result of everyday environmental exposure to oxidants and acids present in the air and water.

			writing assignments are graded and quizzes and a lab final are also given to evaluate student mastery of these skills.	
	3. understand applications and limitations of the sciences;	**Learning Objectives 1.3** 1) identify examples of the limitations of science and the importance of correct usage of units of measure, especially in relation to engineering. 2) examine the current knowledge and illustrate how this knowledge evolved from an historical perspective, how we have improved our knowledge base as time passes, and why we will need to do so in the future to insure a sustainable and safe use of chemicals and materials, especially as they relate to engineering applications.	**Assignments 1.3** Reading and lectures as well as laboratory work is used to understand limitations of science. Examples of misuse of units or miscalculations are stressed in both lectures and laboratory pre-labs. Students are asked to give explanations for why some of the labs may have difficulties due to a variety of variables, including laboratory temperature, laboratory technique, and equipment limitations, stressing this through determining accuracy and precision. Past and current sustainability and environmental issues are discussed in the text and in lecture and labs to note the significant areas where we will need a better understanding of science to overcome some of these pressing issues.	**Explanation 1.3** Engineering students need to recognize that the current status of science and understanding of chemistry and materials limits the applications and capabilities in many areas of engineering. Past and future advances in chemistry and engineering have led to a number of currently practiced concepts and goals in both chemistry and engineering that have led to the concepts of "green" chemistry and engineering.

Educational Goals	Learning Outcomes students will..	Learning Objectives: At the end of the course students will be able to...	Assignments	Explanation
Skills 1 – Communication	1. develop an understanding of how to communicate scientific procedures, results from the inquiry and conclusions resulting from applying the scientific method;	Learning Objectives 1.1 Express the results of applying the scientific method using chemical language which employs formula, equations and graphs.	**Assignments 1.1** Some laboratories are done as separate student endeavors and others are done in teams. Pre-lab assignments are given and graded as part of the students preparation for the laboratory and include organization of thoughts as well as materials needed for the various experiments. Laboratory notebooks are also kept and the data recorded from their experiments with inquiry-based questions to test the students understanding and mastery of the concepts by their written communication of the experimental results. Students are also encouraged during pre-lab discussion to talk about the procedure as well as the outcome of the experiment. Lab reports and notebooks are all graded as part of the students' assignments. Lab attendance and completion of labs for passing grades are stressed.	**Explanation 1.1** Students in chemistry and engineering need to develop strong skills in careful data recording as well as in taking the data and using it to answer a problem or develop results that demonstrate a chemical theory or process, or produce a chemical product that is related to their discipline. These activities all lead to the student learning the importance of clarity in reporting and communicating the results in English using chemical and mathematical languages.

Educational Goals	Learning Outcomes students will...	Learning Objectives: At the end of the course students will be able to...	Assignments	Explanation
Skills 2 – Critical Thinking, Quantitative Reasoning, and Solving Problems Individually and Collaboratively	1. develop basic skills from the scientific method including inquiry, data collection, analysis, and interpretation in order to explore a scientific problem from hypothesis testing to formulating a conclusion based on the inquiry;	**Learning Objectives 2.1** connect the data collection and experiments with discussion of the theory and hypotheses and perform laboratory assignments individually or as a team.	**Assignments 2.1** Pre-lab assignments, and laboratory experiments are performed for some labs individually and for others as a team. Data collection in laboratory is recorded in notebooks and then analyzed and reported in lab reports that are graded individually. Results are interpreted and compared to theoretically anticipated results and deviation from those results are then explained by the student in the report giving plausible answers for the results.	**Explanation 2.1** The labs also include initial training regarding safety. Pre-lab overviews are given before the actual labs to explain the scientific theory or method being examined or used. Proper handling of chemicals and waste disposal are also a part of the labs. Experiments are done in teams to collect and analyze data on a number of chemical topics covered in lecture. These include chemical structure, basic chemical reactions, acid-base chemistry, chemical kinetics, spectroscopy, and chemical equilibria, along with both inorganic and some organic reactions linked to materials production and redox reactions relevant to material exposure in the environment.
	2. learn about the world through observation and experimentation, through modeling and interpretation, and through analysis and evaluation;	**Learning Objectives 2.2** Connect chemical theory and practice to real-world engineering issues including the importance of chemical bonding in the inherent properties of chemicals, from fuel energy content, to structural strength, to resistance to oxidation.	**Assignments 2.2** Lectures and labs make use of experiments and physical and theoretical models to address gas, liquid, and solid phase chemical interactions relevant to the atmosphere and hydrosphere (lakes and oceans). Discussion and experiments that include energy and environmental	**Explanation 2.2** A number of the laboratory experiments have the students work as team members. They also can work as team to do the experimental data work up, but have to submit their pre-lab and lab reports as individuals. During other laboratory modeling and experiments, the students work individually and

			issues are part of the lectures and exams. Quizzes, exams, and laboratory pre-lab and notebook assignments are all used to determine student mastery of these concepts.	report results and turn in assignments individually.

Educational Goals	Learning Outcomes students will...	Learning Objectives: At the end of the course students will be able to...	Assignments	Explanation
Skills 3 – Information Technology	1. develop and apply technological tools for inquiry, analysis, and presentation of scientific information and data;	**Learning Objectives 3.1** 1)use standard chemical equipment, including computer- connected spectrometers and computing software (Excel) spreadsheets to collect and analyze data (including graphical analysis). 2)use web based resources to find information on chemical handling, toxicity, and other safety information.	**Assignments 3.1** Laboratory equipment and a computing laboratory is used in many of the laboratory experiments. Pre-lab assignments in the safety portion of the class at the beginning of the course requires students to find information about specific chemicals in materials safety data sheets (MSDS). The students are also assigned problems in the laboratory experiments that require the use of data spread sheets and analysis in their laboratory reports, such as the graphical analysis of the behavior of reactants to obtain kinetic and equilibrium data. Modern Vernier instrumentation is used as pH meters and spectrometers in several experiments. These instruments take the analog signals from the instrument and digitize it for direct data analysis. The students also take the data from these instruments for further analysis.	**Explanation 3.1** Vernier instrumentation for pH meters and spectrometers used in titration and spectroscopy and kinetic experiments are also used. These instruments take the analog signals from the instrument and digitize it for direct data analysis and the students take the data from these instruments using memory sticks or other data storage for use in the computing laboratory or on other computers using Excel spread sheets for data analysis and reporting.

Educational Goals	Learning Outcomes students will...	Learning Objectives: At the end of the course students will be able to...	Assignments	Explanation
Values 1 – Personal Responsibility and Ethical Behavior	1. take responsibility for completing assignments in an ethical manner, working on one's own when required and acknowledging resources when used;	**Learning Objectives 1.1** Differentiate between acceptable and unacceptable use of other's work.	**Assignments 1.1** Students are required to attend lecture and lab and independently complete all coursework. Students are required to pass the mastery-based Indiana University-Bloomington online Plagiarism test https://www.indiana.edu/~istd/. Students are required to attend lab.	**Explanation 1.1** Credit will not be given for work not completed independently. Missing three labs leads to a failing grade in the course.
	2. develop an understanding of the ethical obligations in conducting research, and of being precise and accurate with data, including how this obligation applies to communication of information;	**Learning Objectives 1.2** 1)Use significant figures and percent error to accurately reflect the precision and accuracy of their data. 2)Use proper safety equipment to ensure their own as well as their classmates well-being.	**Assignments 1.2** Grading rubrics for laboratory reports include points for the correct number of significant digits as well as deductions for percent errors outside the acceptable range. Safety is strongly stressed including the ramifications of not adhering to strict safety guidelines.	**Explanation 1.2** Students are evaluated on their data presentation and how well it is presented. Proper and accurate labeling of data sets, tables, and graphs are stressed in their laboratory reports and laboratory notebooks. Students not taking responsibility for proper safety attire are not allowed to complete labs. Students are also required to wear safety glasses and goggles and have appropriate behavior in labs at all times.

Educational Goals	Learning Outcomes students will...	Learning Objectives: At the end of the course students will be able to...	Assignments	Explanation
Values 2 – Civic Responsibility	1. develop an understanding of the ethical issues that may result when applying scientific knowledge that is incomplete.	**Learning Objectives 2.1** Evaluate the potential for harm that could result from use of incomplete or inaccurate scientific information.	**Assignments 2.1** Students are presented a case study involving Safety Data Sheets being used to make decisions about the environmental impact of a compound.	**Explanation 2.1** Safety Data Sheets, the standard source of chemical safety information, are produced by the manufacturer and are sometimes incomplete.

Additional Comments:

Belinda Blevins - Grade — Approved by Core Curriculum Committee

5-14-14 — Date

Approved by Provost

5/23/2014 — Date

Approved by Chancellor

5/28/14 — Date