

Department: CHEM

Course No.: 122

Credits: 4

Title: Chemical Principles and Applications

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Content Area: CA 3 Science and Technology- Lab

Catalog Copy: CHEM 122 Chemical Principles and Applications Second semester[s]. Four credits. Three class periods and one 1-hour discussion and one 2-hour laboratory per week. Not open for credit to students who have passed CHEM 127 or 129 or 137 or 153. Brief but comprehensive survey of important chemical theories and applications of chemistry. Preparation for one semester courses in organic chemistry or biochemistry. Atomic structures, chemical bonding, chemical reactions, stoichiometry, states of matter, and theories of solutions. Does not fulfill two-semester general chemistry requirement for majors in biology, chemistry, pharmacy, physics, and agriculture and natural resources. Does not satisfy the admission requirements of medical and dental schools. With high grade, may serve as prerequisite for CHEM 128 or 138 or 154.

Course Information: The goal of this course is to give students the rudiments of chemistry so that there will be a foundation for further learning where a basis of chemistry is needed to understand the material being taught. The course starts with several lectures on what is chemistry? It continues with the modern concept of an atom, the principles of chemical bonding and nomenclature, some examples of chemical reactions, the transfer of electrons, the ideal gas, and solution chemistry. Most of the course consists of concepts and principles. However, chemical nomenclature is emphasized. This is because the vocabulary of chemistry is needed for any future discussion of the usage of chemicals. A few of the foundations that this course attempts to convey are acidity as it may apply to soils, pH as it may apply to fermentation processes, solution concentrations as it may apply to saline intravenous solutions, oxidation as it may apply to metabolic processes, and equilibria as it may apply to the buffering nature of blood. The course consists of four hour exams given during the regular class period, daily "quizzes" that are to be used for self examination, and homework problems that are covered in the hour exams. There is a one hour discussion period during the week when the laboratory is explained and any questions that the students may have on the lecture material are answered. The two-hour laboratory supports the lecture. The experiments attempt to illustrate how chemists know what is taking place during a chemical reaction. Various chemical manipulative techniques are demonstrated. There is some familiarization with the nature of some common chemicals.

Meets Goals of Gen Ed:

Acquire intellectual breadth and versatility. CHEM 122 offers students detailed explanations of how experiments were and are used to advance our base of knowledge in science. Models are presented for the nature of atoms and molecules, matter, and chemical reactions. This material

provides students with a broader way to see the world around them than if they relied on a purely social, political, legal, or experiential model for understanding topics such as environmental quality, health care, infrastructure (highways, buildings, public buildings, etc.) consumer products, and warfare. A foundation in the principles of chemistry is essential for an informed world view in a technological society.

The energy needed for our industrial society, the basis of medical science, agricultural science for food production, and materials for our technology are all based on chemistry. As citizens, people need to understand the problems associated with each of these so that intelligent policy decisions can be made. For example, policies with respect to pollution and remediation cannot be made on the basis of emotion alone. An educated person must have some knowledge of chemistry

Acquire critical judgment. Students will continue to be exposed to a plethora of scientific and technical information on health, environment, consumer goods, the impact of war, global warming, and so forth. With the waning adherence to ethical standards particularly, students will hear a lot of inaccurate or partially accurate reports. Without understanding how scientific conclusions are drawn, or how science is transferred to the technical arena, they would be at a loss in interpreting conflicting news reports. Chemistry 122 provides a foundation for evaluating scientific and technical information through critical judgment. Also, by knowing chemical vocabulary, students will be better able to research a topic of interest in their personal lives, and lives of their families and communities. Once again, a critical eye is required to sort through conflicting information obtained from a variety of sources.

Acquire a working understanding of the processes by which they can continue to acquire and use knowledge. Being a course that includes a laboratory, CHEM 122 is an ideal way to understand how an idea can be put to the test. Students learn about past experiments that changed important prevailing theories in previous eras, and they carry out experiments to model this process of scientific inquiry in the lab today. Students have an opportunity to work with the experimental method to answer questions, and can apply this approach when exploring a question of importance in their personal lives, either by looking for answers and evidence in existing documents, or looking for concrete and reliable, repeatable evidence in their own lives.

CA3 Criteria:

1. Explore An Area of Science or Technology by Introducing Students to a Broad, Coherent Body of Knowledge and Contemporary Scientific or Technical Methods. Chemistry 122 is a coherent introduction to the field of chemistry. Students are exposed to some history behind our current theories, as well as the methods used to reach this point in scientific history. Students learn the basic ideas about atoms, molecules, and ions, atomic and molecular structure, nomenclature, reactions, stoichiometry, bonding, phase changes, rates of reactions, energy, solutions, chemical equilibrium, acids and bases, and so forth. The broad areas of chemistry that are emphasized are general, inorganic, and elementary physical chemistry. CHEM 122 provides a foundation for further work in organic and biochemistry, should the student pursue additional courses in chemistry.

2. *Promote An Understanding of the Nature of Modern Scientific Inquiry, the Process of Investigation, and the Interplay of Data, Hypotheses, and Principles in the Development and Application of Scientific Knowledge.* To augment the concepts mentioned in response to item (1) above, students learn about scientific inquiry through detailed discussion of the development of the current quantum mechanical model for the nature of the atom. They learn about the experimental evidence that caused scientists to question each sequential model for atomic structure, and to revise the model to a more sophisticated and useful one. Students carry out their own experiments in the laboratory as a demonstration of the scientific method. In addition, students learn about application of each concept in everyday life or in the world of technology. For example, the physical phenomenon and phenomenal cost to society of the rusting process of iron are considered when studying electron transfer reactions. The color of neon lights is explained by the quantum mechanical concept of the atom. The role of hydrogen bonding in gene expression is described.

3. *Introduce Students to Unresolved Questions in Some Area of Science or Technology and Discuss How Progress Might Be Made in Answering These Questions.* Along with learning the tremendous cost of the rusting of iron, students are also introduced to some ways of preventing rust and other forms of corrosion, or indeed using them to prevent further corrosion, as in the natural formation of a green copper oxide coating on a copper roof. The on-going challenge of rust prevention is part of the discussion of redox reactions. Students are exposed to “big questions” such as how to handle nuclear waste; who should decide? They are introduced to controversy about whether fat in the diet is good or bad for health and whether cold fusion is still a possible remedy for the depletion of petroleum reserves. Their own role in the choices made by our society is considered. Speculation about the mechanism behind a “lemon battery” often used in classroom demonstrations is left up in the air since scientists have not yet settled on an explanation.

CA Lab Criteria: The laboratory portion of this course occupies a two-hour block once a week. Simple experiments that are designed to acquaint students with the nature of chemicals and chemical reactions are carried out. An attempt is also made to select experiments that illustrate the principles being discussed in the lecture portion of the course.

Role of Grad Students: The graduate teaching assistants conduct a 50-minute discussion section once per week. This session is designed to give the students a pre-lab orientation as well as to function as a help session over the material being presented in the lecture. The teaching assistants also supervise the two-hour laboratory. They make sure that the students understand the experiment being conducted. They watch for unsafe practices. They collect the data gathered by the students, and they post-lab work sheets. These are graded and returned to the students. The harmonization between the laboratory sections is accomplished by a 30 minute to one-hour TA meeting once a week. Guidance at these meetings is provided by the designated instructor for the course. An agenda is provided to the teaching assistants prior to the meeting and the minutes of the meeting are distributed within a day of the meeting to remind everyone of the decisions made at the teaching assistant meeting.