Department: CHEM

Course No.: 138Q

Credits: 4

Title: Enhanced General Chemistry

Contact Person: Robert Bohn

Content Area: CA 3 Science and Technology- Lab

WQ: Q only

CatalogCopy: CHEM 138Q Enhanced General Chemistry (Formerly offered as Chemistry 153Q and 154Q). Both semesters. Four credits each semester. Three class periods and one 3-hour laboratory period. Prerequisite: One year of high school chemistry and a high pass on the Q Test. Prerequisite or corequisite: MATH 112 or 115; or consent of instructor. Primarily for majors in chemistry or related disciplines. This course can be used as an alternate wherever CHEM 127Q-128Q is listed as a prerequisite. Not open for credit to students who have passed CHEM 129Q-130Q or 153Q-154Q. Prerequisites for CHEM 137Q: MATH 101 or passed Q Readiness Test or passed a Q course.

Atoms, molecules, ions,chemical bonding. Gases, liquids, solids, solutions, equilibrium, thermodynamics, nuclear chemistry, kinetics and organic chemistry. May include modern materials, environmental chemistry. metallurgy, and biochemistry.

Course Information: The year course, Chem 137-138, provides a general introduction to chemistry including atoms and molecules, phases (gas, liquid, and solid), introduction to thermodynamics and equilibria, chemical kinetics, introduction to quantum theory (bonding, structure, and spectroscopy), nuclear chemistry, and environmental chemistry. Quantitative aspects are dealt with rigorously with considerable attention placed on problem solving and calculating and reporting results sensibly.

Chem 137-138 has these differences from the standard Chem 127-128.

a. Enrollment is encouraged only to chemistry and related majors.
b. Previous chemistry experience is expected and Math 112 or 115 is corequisite.
c. Certain topics are explored with greater depth and rigor.
d. Calculus is included in discussions.
e. Students have a small class environment in their major.
f. The course has 3 lectures and 1 3-hr lab per week.

Meets Goals of Gen Ed:
Acquire intellectual breadth and versatility. Chem 127Q meets the General Education Goal of ass isting students in acquiring intellectual breadth and versatility needed to understand, interpret

and process the increasing amount of scientific data and terms that are often used in today's news. This course gives the students enough technical information so that the students acquire an added dimension to their intellectual capabilities. For example, when we teach carbon-dating, it is our goal that students not only know something about the relics found in a new dig, but also understand something about the technique used to figure out how old the relics are. Furthermore, the students in this course are exposed to both microscopic (molecular size) and observable phenomena. They learn to observe a reaction in a test tube and translate it into a molecular equation. They also learn the reverse. For example, they are taught to predict observable phenomena based on a model of molecular collisions. While most non-scientists generally do not do this, the student will have learned to look at phenomena from several perspectives. This versatility will stand them in good stead at whatever career they pursue.

Acquire critical judgment. This course will assist students in acquiring critical judgement by teaching them to think quantitatively. A lot of public information available these days is in the form of statistical odds, charts or graphs. Since chemical concepts are presented in the context of a mathematical structure, students are taught to think quantitatively. Thinking quantitatively not only involves the algebraic solutions to problems but also the ability to quickly estimate magnitudes and look at the reasonableness of the numerical answers obtained. Knowing the principles involved in a particular scientific process for example, students should be able to analyze and criticize initiatives proposed by government to solve societal ills. After a discussion of fuel cells, students should be able to make a more educated and reasoned judgment on the feasibility and practicality of President Bush's initiative on fuel cell technology.

Acquire a working understanding of the processes by which they can continue to acquire and use knowledge. The scientific method is the cornerstone by which most scientific theories are proposed and most experiments are conducted. The students see this method used over and over again in lecture. They use it several times in the laboratory. It is hoped that by being constantly exposed to this method of scientific inquiry, they embrace it and make it their own. They should use it in exploring, deducing and enunciating their own theories for other non-chemical observations. If they do, they will be adept at seeing the flaws in numerous theories that they read or hear proposed in both scientific and nonscientific contexts.

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.*** This course presents a comprehensive, unified study of the properties of molecules, elements and compounds. Its unifying theme is the periodic table.

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.*** With the periodic table as the backdrop, the students learn about “old”theory, proposed new theory, and the refinement of old theory with each new scientific discovery. The students for example are told about the alchemists and the atomic theory of Dalton which was a repudiation of alchemy. The experimental inquiry into the properties of the elements led to the periodic table which went through 3 different proposed systems of organization, while quantum mechanics led to a refinement of Dalton's theories.

3. ***Introduce Students to Unresolved Questions in Some Area of Science or Technology and Discuss How Progress Might Be Made in Answering These Questions.*** As an example, students are introduced, to the principles of solubility. While solubility may look like simple phenomena, as they go deeper into the subject, they are led to realize that all solubility data is empirical. There is no formal theory that allows a scientist to look at an unknown substance, (from Mars for example) and decide, just by calculation whether it will dissolve or not. More practical open questions could be nuclear waste disposal (that satisfies environmental standards), or alternative fuels. Besides exposing students to such unresolved questions, the unorthodox "solutions" to societal problems are discussed. For example: Chemists should work on a reaction that can convert the bad ozone that causes pollution into the good ozone to fill the ozone hole. Why can't they do that? It is hoped that after taking this course they will not take questions of that nature seriously.

CA3 Lab Criteria: Weekly 3-hour labs explore a variety of physical and chemical properties of materials in all phases.

Q Criteria: Most homework, quiz and exam problems require numerical answers. The level of the problems vary throughout the course. On one end are plug and chug questions where numbers are plugged into a formula to get an answer. The next level requires algebraic manipulations of a formula to solve for a variable in terms of other variables and interpret its quantitative significance. At the other end, some problems require setting up and solving two simultaneous equations or deducing a function from the graph obtained by plotting experimental data. Most of the principles explained and tested for use formulas and functions, linear and quadratic equations. Graphs have to be interpreted and the method of successive approximations is used for occasional cubic equations. The students are also expected to have a working knowledge of powers, roots and logarithms to solve problems. The students (after solving algebraically for numerical answers) are asked to create graphs, draw conclusions, make comparisons and express their results in a precise and accurate manner with an emphasis on scientific notation and significant figures.

Role of Grad Students: Grad TA's supervise the laboratories, grade lab reports, and assist in exam grading.