LSC Use Only Proposal No:

Part II.

New Syllabus of Record

1. Catalog Description

CHEM 112 General Chemistry II (3c-3l-4cr)

Prerequisites: CHEM 111 or 113

Description: Intended for science and pre-professional health majors. This course is [illegible]

the second half of a two-semester sequence designed to give students the foundation of knowledge and laboratory techniques required to successfully complete a degree program in the sciences, or gain entry into professional health programs. Topics include the solid states, solution theory, kinetics, equilibrium, thermodynamics, acids and bases, and electrochemistry. [illegible]

a) Concept of entropy
b) Quantification of entropy

[redacted]

9) Electrochemistry (3 hours)
   a) Oxidation, reduction and half-reactions
   b) Standard reduction potentials
   c) Non-spontaneous electrochemical reactions
10) Final Exam (2 hours during final examination period)

CHEM 112 Laboratory Schedule (one experiment per session)

[redacted]

1. Safety goggles

Heights, IL, 1997.
2. Atkins, P.W.; de Paula, J. *Physical Chemistry*, 9th ed.; W. H. Freeman, New York, 2010.
3. Bertsch McGrayne, S. *Nobel Prize Women in Science: Their Lives, Struggles and Momentous Discoveries*, 2nd Ed.; Joseph Henry Press, Washington, DC, 2001
4. Brown, J. *African American Women Chemists*; Oxford University Press, 2010

From your studies on equilibrium, you know that that any equilibrium that involves H_3O^+ as a product or reactant can be shifted, according to Le Châtelier's Principle, by changing $[H_3O^+]$.

Pure water at 25 ^{0}C has a natural equilibrium that produces $[H_3O^+] = [OH^-] = 1.00 \times 10^{-7}$.

Part II: Volumes of Strong Acid needed to Change pH.

Use a 100 mL beaker to obtain 60 mL of 0.050 M HCl. Clean and rinse a 50 mL burette with a small portion of the HCl, and then fill the burette with the HCl, ensuring there are no air bubbles in the tip.

Use a graduated cylinder to measure 30 mL of your first solution of your assigned set

and pour it into a small beaker. (The depth of the solution must be sufficient to cover the tip of

Obtain two more 30 mL samples of the propionic acid/sodium propanoate mixture, measured with a graduated cylinder and poured into two small beakers.

Carefully titrate one sample of the mixture with 0.0500 M HCl to pH 3.0, to generate a titration curve (pH vs. Volume HCl). In contrast to Parts II and III, your increment volume will vary throughout the titration. Here, your initial increment size of HCl should be about 0.5 mL, but as the pH begins to change more sharply, decrease your increment size, down to dropwise addition between measurements. The point where the pH changes the most steeply is called the equivalence point. You want to obtain a precise measure of the volume needed to get to this

10. Add strong acid or strong base in approximately 0.25 mL increments, and swirl. When the pH reading stabilizes, measure the volume added by reading the burette to ±0.01 mL, and calculate (V[illegible] – V[illegible]) where V[illegible] = V[illegible]. Click "Keep" and enter the calculated volume. Repeat

step 10 for the duration of the titration. Do not "STOP" the data collection until the titration is complete.
11. When you are finished making measurements, click "STOP".
12. For the quantitative analysis of Part IV, click "ANALYZE", "TANGENT", and slide the tangent line along your titration curve until you find the greatest magnitude of the slope. This point is called the equivalence point. The volume of HCl (or NaOH) at the equivalent point will be used to analyze the contents of the mixture.
13. When you are finished, exit from Logger Pro, return the probe to its storage bottle (make sure cap is screwed down tightly so the O-ring seal around the probe does not leak) and logoff the computer.

Experiment BC-1 Report: What makes pH change and by how much?

(AEK 04/18/09)

Report Submitted by ______________________

Date Submitted ________________________

A. Purpose: *The purpose of this experiment is to determine how strong acids and strong bases affect the pH of different solutions, and to analyze the concentrations of*

NH_3		
Distilled water		
$NaCH_3COO$		
$NaHCO_3$		
Propionic acid/sodium propanoate mixture		

1. What trends do you observe? i.e., which solutions react similarly to each other? Group together solutions that required similar amounts of HCl. Which solutions are distinct?

2. For each solution, write the chemical reaction that the cation or anion might have with water.

   CH_3COOH

   $CaCl_2$

   Na_2CO_3

   NH_4Cl

   NH_3

   $NaCH_3COO$

   $NaHCO_3$

   Propionic acid/sodium propanoate mixture

3. Use the reactions in question 2 above to explain the groupings you created in question # 1.

Part III: Volumes of Strong Base needed to Change pH.

In Part III, you and your partners will add strong base to different solutions and record the volume of NaOH needed to increase the pH to 10.

Table Two: Volume of NaOH needed to bring pH = 10

Solution	Initial pH	Volume HCl needed to reach pH = 4
CH_3COOH		
$CaCl_2$		
Na_2CO_3		
NH_3		
Distilled water		
$NaCH_3COO$		
$NaHCO_3$		
Propionic acid/sodium propanoate mixture		

4. What trends do you observe? i.e., which solutions react similarly to each other? Group together solutions that required similar amounts of NaOH. Which solutions are distinct?

5. Use the reactions in questions 2 above to explain the groupings you created in question # 4.

Part IV: Quantitative Analysis of propionic acid/sodium propanoate mixture ($CH_3CH_2COOH/NaCH_3CH_2COO$).

You and your partners will add strong acid and strong base in small increments to the mixture, and measure the pH. Find the volumes of strong acid and strong base where the slopes are the

(i) The strong base will react with the weak acid present in the mixture. Using your balanced equation from (h), calculate the number of moles of weak acid in the mixture.

(j) Calculate the original concentration of weak acid in the mixture, using the moles of weak acid from (i) and the volume of mixture used:

(k) From your instructor, the actual weak acid concentration: ________________ and the actual conjugate base concentration: ________________.

Conclusions

1. In Part II, you added strong acid to CH_3COOH, $CaCl_2$, Na_2CO_3, NH_4Cl, NH_3, Distilled water, $NaCH_3COO$ and $NaHCO_3$. Account for the different volumes of HCl needed to drop the pH to 4.0. Write any chemical reactions that might be occuring between the HCl and the solutions. (Do these reactions account for the differences in volume HCl needed?)

2. In Part III, you added strong base to CH_3COOH, $CaCl_2$, Na_2CO_3, NH_4Cl, NH_3, eistilled water, $NaCH_3COO$ and $NaHCO_3$. Account for the different volumes of NaOH needed to

- Name, the date submitted, and the title of the experiment are at the top of page one.
- The objective of the experiment was described in no more than one or two sentences and was not copied from the lab manual. You should relate the objective to the scenario of this series of

experiments

Summary of Procedure (4 points)

4. Updated course text and bibliography - the syllabus of record was last updated in 2003.
5. Minimum Lab Grade of 70% required for passing course was the recommendation of two external evaluators at our last program review. Faculty approved raising the minimum passing lab grade from 65% to 70% to improve student learning and standards.
6. Included sample laboratory experiment/report and grading rubric associated with Objectives2&4.

4. The old syllabus of record.

[redacted]

I. CATALOG DESCRIPTION

COURSE NUMBER:	CHEM 112
COURSE TITLE:	General Chemistry II
NUMBER OF CREDITS:	4 cr (3c-3l-4sh)
PREQUISITES:	CHEM 111
COURSE DESCRIPTION:	A continuation of General Chemistry I. Topics covered include the solid and liquid state, solutions, kinetics, equilibria, acids and bases, solubility equilibria, thermodynamics, electrochemistry and descriptive chemistry of the elements. Also fulfills Liberal Studies Natural Science Lab Requirement.

II. COURSE OBJECTIVES

[redacted]

equilibrium. LeChatelier Principle.

5. Acid-Base Concepts — 4 lectures
[illegible]
bases. Strength of acid-bases and self-ionization of water.

6. Acid-Base Equilibria — 4 lectures
Acid-base ionizations. Equilibrium constants. Titration curves. Hydrolysis of salts.

7. Solubility and Complex-Ion Equilibria — 4 lectures
The solubility product constant. Common ion effect. Precipitation calculations. Complex-ion formation, complex-ion formation and solubility. Qualitative analysis of metal ions.

8. Chemical Thermodynamics — 4 lectures
The law of the conservation of energy (first law). The second law and entropy, free energy and spontaneity. Equilibrium calculations.

9. Electrochemistry — 5 lectures
Electrochemical cells and electrolytic cells, electromotive force, electrode potentials. Equilibrium constants from
[illegible]

V. REQUIRED TEXTBOOK(S)

Jones and Atkins. *Chemistry: Molecules, Matter, and Change*. 4th Ed., W.H. Freeman and Co., New York, NY, **2000**.

Wink, Gislason, and Kuehn. *Working with Chemistry: A Laboratory Inquiry Program* W.H. Freeman and Co., New York, NY, **2000**.

With respect to content, general chemistry textbooks usually vary little from each other but the General Chemistry Committee has nevertheless agreed to switch textbooks every three to four years (or sooner, if necessary). This allows for renewal and adjustment to the needs of students.

Liberal Studies Course Approval General Information

1. CHEM 112 is a multi-instructor course. In spring 2011, there were three lecture sections (three different instructors) and 11 lab sections (six different instructors). Basic equivalency between sections is fostered in the following ways: a) all lab sections follow the same experiment schedule; b) lecture instructors use the same textbook; c) lecture instructors are