Las Positas College
3000 Campus Hill Drive
Livermore, CA 94551-7650
(925) 424-1000
(925) 443-0742 (Fax)

Course Outline for CHEM 1A

GENERAL COLLEGE CHEMISTRY I

Effective: Fall 2021

I. CATALOG DESCRIPTION:
CHEM 1A — GENERAL COLLEGE CHEMISTRY I — 5.00 units

Introduction to atomic structure, bonding, stoichiometry, thermochemistry, gases, matter and energy, oxidation-reduction, chemical equations, liquids and solids, solutions, chemical energetics and equilibrium concepts. Laboratory includes both quantitative and qualitative experiments.

3.00 Units Lecture 2.00 Units Lab

Prerequisite
MATH 55 - Intermediate Algebra for BSTEM
with a minimum grade of C
or

NMAT 255 - Intermediate Algebra for BSTEM
with a minimum grade of C

CHEM 31 - Introduction to College Chemistry
with a minimum grade of C
The Chemistry 31 prerequisite can be fulfilled by demonstrating the appropriate skill level in the Chemistry Placement Process.

Grading Methods:
Letter Grade

Discipline:
- Chemistry

	MIN
Lecture Hours:	54.00
Expected Outside of Class Hours:	108.00
Lab Hours:	108.00
Total Hours:	270.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. MATH55
1. Recognize and determine the distinctions between relations and functions, numerically, graphically, symbolically, and verbally;
2. Given a function, determine the domain and range and express them in interval notation;
3. Solve polynomial, rational, absolute value, radical, linear, exponential, and logarithmic equations;
4. Apply basic operations on functions, including composition of functions and finding inverse functions;
5. Develop and use equations or function models to analyze and solve applied problems involving linear, quadratic, rational, radical, exponential or logarithmic expressions. Topics should minimally include growth, decay, geometry, optimization and uniform motion.
6. Solve compound inequalities, sketch the graph of the solution and use appropriate set and interval notation to express the solution;
7. Solve absolute value equations and inequalities and, where appropriate, sketch the graph of the solution and use set or interval notation to express the solution;
8. Factor polynomials, including using the sum and difference of cubes;
9. Use the properties of radicals, complex numbers, exponents and logarithms;
10. Sketch the graphs of nonlinear relations, including parabolas and circles, and identify key components of the graphs;

B. NMAT255
1. Recognize and determine the distinctions between relations and functions, numerically, graphically, symbolically, and verbally;

2. Given a function, determine the domain and range and express them in interval notation;
3. Solve polynomial, rational, absolute value, radical, linear, exponential, and logarithmic equations;
4. Apply basic operations on functions, including composition of functions and finding inverse functions;
5. Develop and use equations or function models to analyze and solve applied problems involving linear, quadratic, rational, radical, exponential or logarithmic expressions. Topics should minimally include growth, decay, geometry, optimization and uniform motion.
6. Solve compound inequalities, sketch the graph of the solution and use appropriate set and interval notation to express the solution;
7. Solve absolute value equations and inequalities and, where appropriate, sketch the graph of the solution and use set or interval notation to express the solution;
8. Factor polynomials, including using the sum and difference of cubes;
9. Use the properties of radicals, complex numbers, exponents and logarithms;
10. Sketch the graphs of nonlinear relations, including parabolas and circles, and identify key components of the graphs;

C. CHEM31
1. Define matter and energy;
2. Classify states of matter and describe phase changes using the kinetic molecular theory;
3. Distinguish between elements/compounds/mixtures; physical/chemical, intensive/extensive, endothermic/exothermic changes and/or properties;
4. Solve conversion problems, including metric system and metric to English, and density problems, using dimensional analysis;
5. Convert between the three temperature scales;
6. Solve mathematical problems using significant figures correctly;
7. Describe basic atomic structure using simple quantum theory;
8. Write electron configurations and orbital diagrams for the first twenty elements;
9. Write electron configurations for main group elements and state their relationship to placement of the elements on the periodic table;
10. Name common salts, acids, and molecular compounds by both systematic and common methods;
11. Describe the mole concept and use it in various calculations such as percent composition or determination of empirical/molecular formulas when given percent composition;
12. Perform all levels of stoichiometric calculations (mass, gas and solution) including limiting reagent problems;
13. Perform calculations using the gas laws;
14. Define ionic and covalent bonds and give properties of each;
15. Draw Lewis structures for simple covalent formulas up to four coordinate;
16. Classify chemical reactions by type and predict products (such as single and double replacement, combination, decomposition and combustion);
17. Perform calculations involving molarity and percent concentration for solutions;
18. Classify solutes and write net ionic equations to determine if reaction has occurred;
19. Define acids and bases by Arrhenius and Bronsted-Lowry theories;
20. Perform calculations involving pH, pOH, [H+], and [OH–];
21. Satisfactorily perform the following laboratory procedures and techniques:
    a. Safely handle chemicals in the laboratory;
    b. Weigh chemicals to 0.001 g using a top-loading balance;
    c. Quantitatively transfer solid and liquid chemicals from one container to another;
    d. Correctly use a gas burner;
    e. Accurately measure liquids using analytical volumetric glassware such as graduated cylinders, pipettes, and burettes;
    f. Perform gravity filtrations quantitatively;
    g. Perform an acid/base titration using known and unknown samples;
    h. Measure temperature and barometric pressure;
    i. Accurately and comprehensively observe chemical and physical changes, and record such information in a scientifically correct form;
    j. Correctly plot data and determine the slope of any resulting straight line, using both conventional and computer methods;
    k. Construct models of simple molecules using model kits and Lewis structures;
    l. Determine the conductivity of a variety of chemicals in solution;
    m. Maintain laboratory records in proper form and detail.
22. Describe and follow self-protection procedures;
23. Describe and follow basic laboratory safety rules;
24. Describe and follow procedures for safe handling of chemicals and glassware;

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Solve complex problems involving the concepts listed under course content;
B. Write short explanations describing various chemical phenomena studied;
C. Write balanced chemical equations including net ionic equations;
D. Write balanced chemical equations for oxidation-reduction reactions;
E. Describe the different models of the atom;
F. Use standard nomenclature and notation;
G. Calculate enthalpies of reaction using calorimetry, Hess's Law, heats of formation, and bond energies;
H. Describe hybridization, geometry and polarity for molecules and polyatomic ions;
I. Draw Lewis dot structures for molecules and polyatomic ions;
J. Describe bonding in compounds and ions;
K. Describe simple molecular orbitals of homonuclear systems;
L. Predict deviations from ideal behavior in real gases;
M. Explain chemical and physical changes in terms of thermodynamics;
N. Describe the nature of solids, liquids, gases and phase changes;
O. Describe metallic bonding and semiconductors;
P. Describe network covalent bonding;
Q. Define concentrations of solutions in terms of molarity, molality, normality, percent composition, and ppm;
R. Describe colligative properties of solutions;
S. Solve solution stoichiometry problems;
T. Determine the extent of molecular reactions through the study of equilibrium;
U. Solve simple problems involving gas phase equilibria;
V. Apply Le Châtelier's principle to equilibria;
W. Utilize library and Internet resources in Chemistry;
X. Collect and analyze scientific data, using statistical and graphical methods;
Y. Perform volumetric analyses;
A@. Use a barometer;
AA. Use a visible spectrophotometer;
AB. Use an atomic absorption spectrometer

AC. Perform gravimetric analysis
AD. Acquire and analyze data with a computer and appropriate software.

V. CONTENT:
A. Review of matter and energy
B. Chemical equations, including net ionic equations, and chemical reactivity
C. Oxidation-reduction reactions, including balancing equations in acidic or alkaline solutions
D. Nomenclature
E. S.I. and metric units, including prefixes that range from at least T through f
F. Stoichiometry, including complex problems that apply stoichiometric principles in nonstandard ways
G. Atomic structure including an introduction to quantum mechanics and electron configurations for all the elements in the periodic table
H. Chemical bonding
1. Lewis structures, including substances that violate the octet rule
2. Molecular geometry, including 5 and 6 coordinate systems
3. Hybridization
4. Molecular Orbital Theory
I. Thermochemistry
1. Calorimetry
2. Heats of formation
3. Hess's Law
4. Bond energies
J. Gases
1. Ideal
2. Non-ideal
K. Liquids, solids, metallic bonding, and bonding in network covalent crystals
L. Solutions, solution stoichiometry, and colligative properties
M. Intermolecular forces of attraction
N. Molecular equilibria and general properties of equilibrium

VI. LAB CONTENT:
A. Lab safety
B. Calorimetry experiment(s)
C. Titration experiments
D. Gravimetric experiment(s)
E. Gas law experiments
F. Spectroscopy experiments such as visible and atomic absorption
G. Experiments utilizing computers equipped for data acquisition
H. Using graphing software to plot graphs and find equation of straight line
I. Building of 3-D models of molecules

VII. METHODS OF INSTRUCTION:
A. **Lecture** - informal with student questions encouraged
B. Models, periodic tables, videos, overhead transparencies
C. Safety and proper respect for chemicals and scientific apparatus are constantly stressed.
D. **Demonstration** -
E. **Lab** - Laboratory experimentation, including computer acquisition of data
F. **Simulations** - Computer simulations

VIII. TYPICAL ASSIGNMENTS:
A. Read Chapter 4 in Zumdahl and turn-in solutions and answers to questions # 5, 7, 10, 13, 15, 23, 26, 28, 30, 32, 36, 42, 44, 48, 52, 61, 66, 70ab, 74, 82, 84, 90, 91, 100, 109, 110, 111, 112, 113, 114, 117, 118, and 121
B. Complete a worksheet on molecular geometry.
C. Write correctly balanced oxidation/reduction equations for 20 reactions.
D. After completing the experiment "Spectroscopic Analysis of Crystal Violet", use spreadsheet software to generate two graphs:
1. Absorbance vs. wavelength (to find optimum wavelength)
2. Beer's Law plot (to determine concentration of product).

IX. EVALUATION:
Methods/Frequency

A. Exams/Tests
Minimum 3 midterms and a final exam
B. Quizzes
At the discretion of the instructor
C. Home Work
For every chapter
D. Lab Activities
Weekly
E. Other
1. Weekly written lab reports graded on criteria that may include the following:
a. Description of experimental procedures
b. Completeness of data collected
c. Quality of data collected
d. Computational precision and accuracy
e. Accuracy and precision of experimental laboratory results
f. Proper use of symbolic notation
g. Quality of analysis of scientific principles explored
h. Quality of narrative explanations and reasoning
i. Representation of data in tables or diagrams

X. TYPICAL TEXTS:

1. Zumdahl, Steven, Susan Zumdahl, and Donald DeCoste. *Chemistry*. 10th ed., Cengage Learning, 2018.
2. Tro, Nivaldo. *Chemistry: A Molecular Approach.* 5th ed., Pearson Education, Inc., 2020.
3. Silberberg, Martin, and Patricia Amateis. *Chemistry: The Molecular Nature of Matter and Change*. 8th ed., McGraw-Hill Education, 2018.
4. Las Positas College Faculty Past and Present. Chemistry 1A: General Chemistry Laboratory Manual. Las Positas College , 2017.

XI. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Safety goggles approved for chemistry laboratory
B. Scientific calculator
C. Student lab notebook