Las Positas College
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Course Outline for CHEM 31

INTRODUCTION TO COLLEGE CHEMISTRY

Effective: Fall 2021

I. CATALOG DESCRIPTION:
CHEM 31 — INTRODUCTION TO COLLEGE CHEMISTRY — 4.00 units

Elementary concepts of chemistry with emphasis on mathematical calculations; includes nomenclature, stoichiometry, atomic structure, gas laws, and acids and bases. Designed for majors in science and engineering.

3.00 Units Lecture 1.00 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

Grading Methods:
Letter or P/NP

Discipline:
- Chemistry

	MIN
Lecture Hours:	54.00
Expected Outside of Class Hours:	108.00
Lab Hours:	54.00
Total Hours:	216.00

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;

IV. MEASURABLE OBJECTIVES:

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

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

V. CONTENT:

A. Safe handling of chemicals and proper techniques for use of scientific instrumentation
B. Review of relevant mathematics, scientific notation, significant figures, dimensional analysis
C. SI system of measurement, including the prefixes G, M, k, c, m, μ, n, p, and f
D. Definitions and classifications of matter and energy
E. Simple calorimetry based on specific heats of materials
F. Atomic structure and periodicity at a beginning level with little quantum mechanics
G. Mole concept, including all levels and variations of stoichiometric calculations but with straightforward problems
H. Chemical bonding: ionic, covalent, Lewis structures for simple molecules
I. Gas laws (ideal gases only)
J. Reactions: balancing equations, classification, prediction of products
K. Solutions: definitions, molarity, percent concentration, stoichiometry and titration calculations
L. Net ionic equations
M. Arrhenius and Bronsted-Lowry acid-base theories
N. pH calculations using integer values only

VI. LAB CONTENT:

A. Lab safety
B. Measurement of mass, volume, temperature, and density
C. Gravimetric analysis
D. Observe and analyze various types of chemical reactions
E. Construction of molecular models
F. Collection of gases; measurement of pressure, volume, and temperature
G. Conductivity of substances and solutions
H. Preparation of solutions
I. Acid/base titration
J. Data analysis, including graphical analysis

VII. METHODS OF INSTRUCTION:

A. Classroom and laboratory demonstrations and computer simulations
B. **Lecture** - (informal, with student questions encouraged)
C. Individual and group work in the laboratory
D. Use of models, periodic tables, audio-visual media including PowerPoint

VIII. TYPICAL ASSIGNMENTS:

A. Minimum of 8 homework problems per unit or chapter usually taken from those for which the textbook author has not provided answers.
B. Prepare a solution of sodium hydroxide.
    1. Standardize this solution by titration against primary standard potassium hydrogen phthalate
    2. Use the NaOH solution to determine the molarity of acetic acid in vinegar by titration.

IX. EVALUATION:
Methods/Frequency

A. Exams/Tests
    Minimum 3 midterm exams and a final exam
B. Quizzes
    At the discretion of the instructor
C. Home Work
    For each chapter
D. Lab Activities
    Weekly
E. Other
    1. Weekly written laboratory reports for all experiments based on departmentally approved experiments and 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 laboratory results
        f. Proper use of symbolic notation
        g. Quality of analysis of scientific principles explored
        h. Quality of narrative explanations and reasoning

X. TYPICAL TEXTS:
1. Peters, Ed, and Mark Cracolice. *Introductory Chemistry: An Active Learning Approach.* 7th ed., Cengage Learning, 2020.
2. Tro, Nivaldo. *Introductory Chemistry.* 6th ed., Pearson, 2017.
3. Zumdahl, Steven, and Donald DeCoste. *Introductory Chemistry: A Foundation.* 9th ed., Cengage Learning, 2018.
4. Las Positas College Faculty. Laboratory Manual for Chemistry 31: Introduction to College Chemistry. Las Positas College , 2017.

XI. OTHER MATERIALS REQUIRED OF STUDENTS:
A. Safety goggles approved for splash protection in chemistry laboratories
B. Scientific calculator
C. Student Lab Notebook