Mt. San Jacinto College
Integrated Course Outline of Record

Form B

Submitted by:	Farah Firtha	**Date:**	12/17/2020

Department	Subject	Course Number	Title
Chemistry	Chemistry CHEM	100	Introduction to Chemistry

Units/Hours

Each lecture unit requires 1 hour per week of class time, and 2 hours per week of study outside of class.
Each laboratory unit requires 3 hours per week of class time.
Each activity unit requires 2 hours per week of class time and 1 hour per week of study outside of class.

Lecture Units	Lab Units	Total Units
3.00	1.00	4.00
Lecture Contact Hours	**Lab Contact Hours**	**Total Contact Hours**
48.00 - 54.00	48.00 - 54.00	96.00 - 108.00
Lecture Homework Hours	**Lab Homework Hours**	**Total Learning Hours**
96.00 - 108.00	0	192.00 - 216.00

Stand Alone:

Program Applicable

AA/AS Degree General Ed Breadth Area(s):

A NATURAL AND PHYSICAL SCIENCES

General Education Justification:

CHEM100 is consistent with the intent of Area A, Natural and Physical Sciences, because the course focuses on examination of the physical universe and anthropogenic effects. Students will use experimentation, problem solving, qualitative and quantitative analysis to analyze compounds, ions, and solutions (GELO 4). The course also allows students to evaluate the behavior of ideal gases by formulation of hypotheses that are based on the kinetic molecular theory and the scientific method (GELO 2). Students will safely and competently use laboratory equipment while exploring the physical and chemical characteristics of various systems through scientific inquiry (GELO 5,6).

Maximum Enrollment: 25

Maximum Enrollment Justification: Course has safety or compliance factors which influence the

enrollment cap â€“ check all that apply:

*** Course has safety or health reasons that the class should have a non-standard enrollment cap.**

*** Course has specific standards outside of the college calling for a specific or capped class size.**

*** Course has an advisory panel or an external accreditor which recommends or requires a specific teacher to student ratio.**

Justification: CHEM100 is a combined lecture and laboratory course offered over a single-semester. Students perform laboratory experiments with a number of chemicals and reagents that are toxic, corrosive and/or irritants to the skin, eyes, and respiratory system. During each laboratory session, students are transporting these chemicals and reagents as well as glassware and other equipment from a dispensing area across the lab to their bench where they carry out procedures. Many labs also require the use of Bunsen burners with open flames. American Chemical Society (ACS) has recommended guidelines of 50 sq ft per student to ensure safety in the learning environment of a student chemistry laboratory. More than 25 students in the laboratory would constitute a safety hazard.

Grading Method: Letter Grade or P/NP

TOP code: 1905.00

Can be Taken 1 **time(s) for credit** (max 4)

- Visual or Performing Arts course that is required to meet major requirements for UC/CSU
- Intercollegiate athletics course
- Academic/vocational competition course

Catalog Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course). (**75 words** or less in gray box below).

This course is a survey of basic chemistry topics. The topics covered are: metric system and numbers, chemical view of matter, periodic table of elements, atomic theory, chemical bonds, chemical equations, stoichiometry, and solutions. This

course is intended as preparation for majorâ€™s chemistry, allied health, and general education.

Schedule Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course). (**25 words** or less in gray box below).

This course is a survey of basic chemistry topics. The metric system, solutions, the periodic table, atomic theory and stoichiometry are some of the major topics covered. This course is intended as preparation for majorâ€™s chemistry, allied health, and general education.

Need for the course:

This course offers an introduction to chemistry, focusing on the study of atomic structure and geometry of molecules. The course uses college level mathematics to explain chemistry concepts in quantitative terms and provides students with introductory knowledge and skills to explain the science of chemistry. Chemistry 100 is transferable to CSU and UC. It can be used for: HS - A.S.-T in Public Health Science for Transfer - Associate in Science, IDS - Liberal Arts: Mathematics & Science Emphasis - Associate in Arts, IDS - Science - Associate in Science, NUTR - A.S.-T. in Nutrition and Dietetics for Transfer - Associate in Science, TEDS - A.A.-T. in Elementary Teacher Education for Transfer - Associate in Arts.

Prerequisite(s):

Prerequisites go through a separate approval process. See Forms E1-E6 for details.
(For further clarification, contact the Prerequisite Subcommittee)

- Appropriate Multiple Measures placement or completion of Intermediate Algebra meets the prerequisite for this course.

Corequisite(s):

Corequisites go through a separate approval process. See Forms E1-E6 for details.

-none-

Recommend Preparation:

Recommended Preparation goes through a separate approval process. See Forms E1-E6 for details.

-none-

Other Enrollment Criteria:

-none-

Learning Objectives:

(please number each objective and express in behavioral terms)
Upon the completion of the course the student will be able to do the following:

1. Convert from one system of units to another using dimensional analysis, and determine the proper number of significant figures when performing calculations.
2. Apply the Scientific Method to experimental analyses and describe each aspect of the scientific method, including measurable variables and controls.
3. Illustrate symbols for elements, isotopes and chemical formulas as well as write the names for those symbols.
4. Specify all components of a balanced chemical equation and calculate theoretical and percentage yields using balanced chemical equations.
5. Analyze atomic structure using the Modern, Bohr, and Quantum Mechanical views, and predict the electron configurations and orbital diagrams of atoms.
6. Compare and contrast the different types of bonds formed in molecules by writing Lewis Structures and discussing the

concepts of electronegativity, bond polarity, dipole moments and VSEPR theory.

7. Describe postulates for the Kinetic Molecular Theory of Gases and calculate the variables of temperature, pressure, volume and moles of gases using the principles of Charles' Law, Avogadro's Law, Boyles Law, and the ideal gas equation.

8. Explain the pH scale and calculate molarity and mass percent of standard and diluted solutions.

9. Analyze states of matter and classify substances using the characteristics of each state; compare and contrast pure substances with mixtures, and propose properties of an element using the periodic table and periodic trends.

Lab Objectives

1. Demonstrate safe laboratory practices and proper chemical hygiene.
2. Accurately read and record experimental data and evaluate, analyze, interpret, and/or calculate results.
3. Conduct experimental procedures to the specifications of written laboratory protocols.
4. Demonstrate safe and effective use of laboratory equipment.

Course Content:

(please number the outline of main topics and subtopics)

1. Chemical Foundations
    1. the scientific method
    2. scientific notation
    3. units of measurement
    4. uncertainty in measurement
    5. significant figures in calculations
    6. dimensional analysis
    7. temperature and density
    8. properties and classification of matter
2. Atoms, Molecules, and Ions
    1. Dalton's atomic theory
    2. the modern view of atomic structure
    3. molecules, ions, and isotopes
    4. introduction to the periodic table
    5. naming inorganic compounds
3. Chemical Quantities
    1. atomic masses
    2. the mole
    3. molar mass
    4. percent composition of compounds
    5. empirical formula calculations
4. Types of Chemical Reactions and Solution Stoichiometry
    1. balancing chemical reactions
    2. aqueous solutions, strong and weak electrolytes
    3. types of chemical reactions: single and double displacement reactions, combustion, oxidation-reduction, precipitation, acid base, gas evolition
    4. stoichiometric calculations
    5. percent concentration and molarity calculations
    6. theoretical and percent yield calculations
    7. titrations and acid base reactions
    8. solution stoichiometry
5. Gases
    1. Pressure
    2. Boyle's Law, Charles' Law, and Avogadro's Law
    3. Ideal Gas Law
    4. Gas Stoichiometry
    5. Dalton's Law of Partial Pressure
    6. the kinetic molecular theory
6. Thermochemistry

1. energy and heat transfer
2. calorimetry and specific heat

7. Atomic Structure and Periodicity
    1. electromagnetic radiation
    2. atomic spectra
    3. the Bohr Model of the atom
    4. the quantum mechanical model of the atom
    5. orbital shapes and energies
    6. the aufbau principle
    7. electron configurations of atoms
    8. atomic properties and the periodic table
8. Chemical Bonding: General Concepts
    1. types of chemical bonds
    2. electronegativity
    3. bond polarity and dipole moments
    4. electron configurations of ions
    5. covalent bonds
    6. Lewis structures
    7. molecular structure and VSEPR theory
9. Solids and Liquids
    1. intermolecular forces
    2. energy requirements and phase transitions
    3. properteis of a liquid: viscosity, adhesive forces, cohesive forces, surface tension
    4. types of solids
10. Solutions
    1. types of soltutions, unsaturated, saturated, and supersaturated
    2. concentrations: mass percent, molality, molarity
    3. dilutions
    4. colligative properties of vapor pressure, melting point, and freezing point
11. Acids and Bases
    1. properties of acids and bases
    2. pH scale calculations
    3. buffers

Lab Content:

(please number the outline of main topics and subtopics)

1. Chemical Foundations
    1. units of measurement
    2. uncertainty in measurement
    3. significant figures in calculations
    4. dimensional analysis
2. Stoichiometry
    1. atomic masses
    2. the mole
    3. molar mass
    4. percent composition of compounds
    5. determining the formula of a compound
    6. balancing chemical equations
    7. stoichiometric calculations
    8. theoretical yield calculations
    9. percentage yield calculations
3. Types of Chemical Reactions and Solution Stoichiometry
    1. aqueous solutions: strong and weak electrolytes

2. the composition of solutions
3. types of chemical reactions : precipitation, acid-base and oxidation-reduction reactions
4. titration

4. Gases
1. pressure
2. the gas laws of Boyle, Charles, and Avogadro
3. the Ideal gas law
4. Dalton's law of partial pressure

5. Thermochemistry
1. energy, enthalpy and calorimetry
2. specific heat

6. Atomic Structure and Periodicity
1. electromagnetic radiation
2. atomic spectra
3. periodic trends in atomic properties

7. Bonding: General Concepts
1. types of chemical bonds
2. electronegativity
3. bond polarity and dipole moments
4. Lewis structures
5. molecular structure and VSEPR theory

8. Solutions
1. colligative properties

9. Acids and Bases
1. pH scale
2. buffers

Methods of Instruction:

Methods of instruction may include, but are not limited to the following:

- **Method:** Lecture
  Integration: Use of presentation software (powerpoint, etc) and whiteboard will be used to demonstrate conversions from one system of units to another using dimensional analysis.
- **Method:** Lab Activities
  Integration: Wet and dry chemical laboratory experiments will be used to derive the theoretical yield and percentage yield of a reaction.
- **Method:** Film/video Viewing and Discussion
  Integration: Videos can be used to help predict electron configuration and orbital diagrams for various elements.
- **Method:** Observation and Demonstration
  Integration: Demonstrations of reactions and calculations can be used to calculate pressures,partial pressures, volumes, temperatures, and moles of gases using the principles of Charlesâ€™ Law, Avogadroâ€™s Law, Boyles Law, and the ideal gas equation.
- **Method:** Discussion
  Integration: Discussions can be used help distinguish the components of the atom using the Modern, Bohr and Quantum Mechanical views of atomic structure.
- **Method:** Online Activity/Discussion
  Integration: Simulations and video activities and demos afford opportunities for students to practice and observe proper experimental techniques.

Methods of Evaluation:

A student's grade shall be determined by the instructor using multiple measures of performance related to the course objectives. Methods of evaluation may include but are not limited to the following:

- **Method:** Exams/Tests
  Integration: Please evaluate based on correctness. Exam format can be multiple choice, short answer, or recognition and evaluation of figures, tables, and diagrams to access proficiency in defining terms and performing chemical calculations to the correct significant figures. Midterm Exams and Lab Practicums should constitute no more than 35% to 50% of the course grade. Final Exams should constitute no more than 20-30% of the course grade. The department exam should be used for the final exam.
- **Method:** Homework
  Integration: Please evaluate based on correctness. Homework assignments can be used to evaluate application of dimensional analysis and overall improvement of problem solving skills. Homework should constitute no more than 0 to 15% of the course grade.
- **Method:** Other
  Integration: Please evaluate based on correctness and completeness. Laboratory exercises assess how the students are learning practical application of chemistry concepts in a laboratory setting, and proper use of glassware, equipment, and chemical supplies throughout every lab. Also assessed during lab are derivations of theoretical and percentage yield of a reaction, calculated with accurate data and proper use of significant figures. Laboratory exercises can be used to evaluate safe and effective use of equipment, chemicals, and supplies while monitoring preparedness, organizational skills, and data analysis. Laboratory exercises should constitute no more than 30 to 40% of the course grade.
- **Method:** Quizzes
  Integration: Please evaluate based on correctness. Quizzes evaluate student safety training, safe laboratory and chemical hygiene practices and student knowledge of personal protective equipment, injury prevention, chemical spills, and minor first aid.

Examples of Assignments:

Students will be expected to understand and critique college level texts or the equivalent. Reading and writing, as well as out of class assignments are required. These assignments may include but are not limited to the following:

A variety of questions are assigned for each section of the course. The following are intended to indicate the level of difficulty for homework problems and test questions for the Introductory Chemistry level.

1.
a) Perform each of the following conversions to the correct number of significant figures
    1. 33 mm to km
    2. 450 cg to ng
b) A glass bead with a mass of 5.96 g is dropped into a beaker of water containing 10.2 mL. If the resulting volume is 12.3 mL, what is the density of the bead?
c) Classify the following as chemical or physical properties:
    1. Magnesium metal tarnishes in air
    2. Magnesium metal melts at 922K
d) Compare and contrast 5 properties of metals and nonmetals
e) Write the formulas for the following inorganic compounds:
    1. Sodium sulfate
    2. Calcium phosphate

2.
a) For each of the following chemical formulas, give the number of each atom in the formula:
    1. $(NH_4)_2SO_4$
    2. $CuSO_4 \cdot 5H_2O$
b) Calculate the formula mass of each compound below:
    1. $Ba_3(PO_4)$

2. $(NH_4)_2CO_3$

c) What is the % C in CO_2?

d) Balance the following reaction equations:

1. $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
2. $H_2SO_4 + KOH \rightarrow H_2O + K_2SO_4$

e) Given the reaction:

$Ca(OH)_{2(aq)} + 2HCl_{(aq)} \rightarrow 2\ H_2O_{(l)} + CaCl_{2(s)}$

When 1.00 g of each reactant is combined:

1. What is the theoretical yield of H_2O?
2. The limiting reagent?

3.

a) How many grams of sucrose must be added to 375 grams of water to prepare a 2.75% (m/m) solution of sucrose?

b) A typical dose of iron (II) sulfate ($FeSO_4$) used in the treatment of iron-deficiency anemia is 0.35 g. How many ml of a 0.10 M $FeSO_4$ solution would be needed to supply this dose?

c) What is the molarity (M) of a solution prepared by diluting 65 ml of a 0.95 M solution to a final volume of 135 ml?

4.

a) Consider the following: 22.4 L of He at 25 °C are heated to 200. °C. What is the resulting volume?

b) A sample of oxygen gas occupies 500.0 mL at 722 torr and –25 °C. Calculate the temperature in °C if the gas has a volume of 2.53 L at 491 mm Hg.

c) Pump 520 mm Hg N_2 and 250 mm Hg O_2 into an empty gas cylinder. What is the overall pressure of the mixture?

d) Given the following data, determine the energy in joules:

80 g water are heated to obtain a temperature increase of 50°C; specific heat of water is 4.18 J/g °C

5.

a) Draw the electron configurations and orbital diagrams for each of the following elements: Be, Ne, Na, Cl, Cr, Cu

b) Place the following elements in order of increasing electronegativity, atomic radius, ionization energy, and electron affinity: Mg, K, N, F

c) Draw Lewis structures for:

1. CO_3^{-2}
2. NaCl

d) Draw the VSEPR sketch for each of the following molecules, state the molecular geometry and determine if each molecule is polar or nonpolar

1. H_2O
2. Formaldehye

e) Write structures for the following organic compounds: 2-butene, cyclohexane, pentane

Example of a Laboratory Assignment

The following sample laboratory assignment is intended to indicate the level of difficulty for a laboratory assignment at the Introductory Chemistry level.

Single Displacement Reactions

Purpose

1. To become familiar with single displacement reactions
2. To interpret the activity series of metals and halogens
3. To predict single displacement reactions with a variety of compounds and elements

Sample Prelab Question:

For each of the following reactions, refer to Figure A and complete the reaction with the correct products. If no reaction occurs, write NO RXN in place of the products.

a) 3 Fe (s) + 4 H_2O (g) →

b) Fe(s) + $CuSO_4$ (aq) →

c) Cl_2 (g) + 2 KI (aq) →

Procedure

I. Single displacement reactions

1. Set up and number 4 test tubes (1-4). To the first and second test tubes, transfer 5.00 mL of $CuSO_4$. To the third and fourth test tubes, transfer 5.00 mL $ZnSO_4$. Record your observations of each solution. Obtain one strip of copper and one strip of zinc. Record your observations of the metal strips then place the zinc strip into the first test tube and the copper strip into the third test tube.

2. Allow the four test tubes to incubate at room temperature for 30 - 40 minutes. Record your observations of the solutions and the metals in each of the four test tubes. Compare the solution in the second test tube to that in the first. Compare the solution in the fourth test tube to that in the third. Recall that the second and fourth test tubes are controls. Do your observations indicate that a chemical reaction occurred in test tubes 1 and 3?

Dispose of the solutions in your test tubes in the waste container provided in the hood. Rinse, dry and return the zinc and copper metal strips to the stockroom.

Sample Report Sheet Data and Results Analysis:

Record all observations of the metal strips and solutions in the data and results table.

Data and Results Table

	Zinc Strip	Copper Strip	$CuSO_4$ Solution	$ZnSO_4$ Solution
Initial Observations				
Final Observations				

Questions

1. If a chemical change occurred, in which test tube(s) (1-4) did the change occur?

2. Which of the following reaction systems is most stable? (hint: think about chemical reactivity).

$Zn + Cu^{2+}$

$Cu + Zn^{2+}$

3. If no reaction occurred, use the reactivity series to explain why.

Textbooks:

- Tro (2018). *Introductory Chemistry 6th edition* Pearson. ISBN: 978-0134302386
- No newer textbook available (2020). *No newer textbook available* No newer textbook available. ISBN: 000-0000000000

Other Resources:

- MSJC. Introductory Chemistry Lab Manual. MSJC , 08-01-2020.

Minimum Qualification

- Chemistry (Masters Required)