CHEM R122: GENERAL CHEMISTRY II

Originator
atoypalmer

College
Oxnard College

Discipline (CB01A)
CHEM - Chemistry

Course Number (CB01B)
R122

Course Title (CB02)
General Chemistry II

Banner/Short Title
General Chemistry II

Credit Type
Credit

Start Term
Fall 2021

Catalog Course Description
This course covers solution equilibria, kinetics, electrochemistry, radiochemistry, transition metal chemistry, and descriptive chemistry of the elements. In addition, an introduction to organic chemistry is included. Lab work includes qualitative analysis, thermochemistry, and kinetic studies, and further develops inorganic preparative techniques. Computers are utilized for data acquisition and interpretation.

Taxonomy of Programs (TOP) Code (CB03)
1905.00 - Chemistry, General

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
May be required

Grading method
Letter Graded

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
105
Maximum Contact/In-Class Laboratory Hours
105

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
157.5
Total Maximum Contact/In-Class Hours
157.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
262.5
Total Maximum Student Learning Hours
262.5

Minimum Units (CB07)
5
Maximum Units (CB06)
5

Prerequisites
CHEM R120

Entrance Skills

Entrance Skills
Perform conversions and other calculations related to chemical reactions, equilibrium and thermodynamics.

Prerequisite Course Objectives
CHEM R120-Perform conversions in the metric system using memorized conversions and the technique of dimensional analysis.
CHEM R120-Perform stoichiometric calculations based on chemical formulas and balanced chemical equations.
CHEM R120-Perform thermodynamics calculations involving calorimetry, Hess's Law, and heat of formation.
CHEM R120-Describe gases, liquids, and solids and perform calculations involving these three phases. Relate properties of each to Kinetic Molecular Theory and intermolecular forces.
CHEM R120-Discuss solutions and factors governing solubility. Perform calculations involving concentration units, especially dilution and neutralization.
CHEM R120-Use the concept of equilibrium and equilibrium constant to describe and perform calculations on equilibrium systems, especially in the gas phase. Apply Le Chatelier's Principle to predict response of equilibrium system to perturbations in concentration, temperature, and pressure.

Entrance Skills
Be able to convert between chemical name and formula and write balanced chemical reactions.

Prerequisite Course Objectives
CHEM R120-Write the names and symbols of common elements. Name or give the formulas of simple inorganic compounds.
CHEM R120-Write and balance chemical equations including net-ionic equations.

Entrance Skills
Describe the atom on the subatomic level and relate periodicity to electronic configurations, bond structure, chemcial properties and shapes.

Prerequisite Course Objectives
CHEM R120-Describe the structure of the atom according to Rutherford's Experiment and Bohr's Theory. Give the modern wave mechanical view of the atom in terms of electronic orbitals.
CHEM R120-Relate periodic properties to electronic configurations of the elements.

CHEM R120-Give the four quantum numbers of an electron in a particular atomic orbital, and their role in describing the location and energy of the electron.
CHEM R120-Describe covalent and ionic bonding in terms of Lewis Dot Theory, Valance Bond Hybridization, and VSER (Valence Shell Electron Pair Repulsion). Relate chemical and physical properties to bonding and structure.

Requisite Justification

Requisite Type

Prerequisite

Requisite

CHEM R120

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Content review

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	Quantitatively and qualitatively describe acid/base and solubility equilibria in solution.
2	Determine rate law from experimental data for several kinetic runs for a reaction.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	Quantitatively and qualitatively describe acid/base and solubility equilibria in solution. Identify acids and bases in terms of Arhenius, Bronsted-Lowry, and Lewis Theory.
2	Determine the spontaneity of process from quantitative and qualitative determination of changes in entropy, enthalpy, and free energy. Determine variation of spontaneity with temperature and concentration changes. Relate free energy and equilibrium constant.
3	Balance redox equations. Calculate standard cell potentials from tables of reduction potentials. Identify components of a voltaic or electrolytic cell. Write balanced equations for the redox reactions involved. Use the Nernst Equation to calculate non-standard cell potentials and the value of the equilibrium constant for redox reactions. Relate free energy and cell potential to redox reaction spontaneity.
4	Give rate laws for first and second order reactions. Determine rate law from experimental data. Relate rate law and reaction mechanism. Describe effect of temperature upon reaction rate and calculate activation energy from rate verses temperature data.
5	Write and balance nuclear equations for various types of radioactive decay. Explain and predict nuclear stability and decay processes based on n/p (neutron/proton) ration and the periodic table. Calculate binding energy, mass defect, and energy of nuclear reactions. Relate decay rate, half life, and sample age. Describe nuclear fission and fusion processes and their utilization as energy supplies. Discuss biological effects of nuclear radiation and environmental problems associated with nuclear waste.
6	Apply VSEPR (Valence Shell Electron Pair Repulsion) Theory to predict molecular shapes. Apply hybridization and valence bond theory to explain how the molecular shape is attained and to describe multiple bonding. Apply simple molecular orbital theory and energy level diagrams to determine electron configuration, bond order and magnetic properties of diatomic molecules of second-row elements.
7	Discuss periodic properties and chemical reactions of main group metals and non-metals.
8	Describe the physical and chemical properties of transitional metals. Name coordination compounds, including isomers, and discuss their spectroscopic and magnetic properties in terms of crystal field theory.

Course Content

Lecture/Course Content

Lecture:

1. Solution Equilibria
   a. pH, strong and weak acids/bases theories, including weak organic acids and bases
   b. Buffers and titration curves of mono- and polyprotic acids
   c. Solubility equilibria, Ksp (the solubility-product constant), common ion effect
2. Thermodynamics
   a. Second law, enthalpy, entropy, free energy, spontaneity
   b. Free energy and equilibrium constant
3. Electrochemistry
   a. Balance redox equations
   b. Voltaic/Galvanic cells, cell potential, half cell reactions, reduction potential tables, spontaneity, free energy, and cell potential; Keq (equilibrium constant)
   c. Electrolytic cells, Faraday's Law calculation
4. Kinetics
   a. Rate Laws, determination from concentrations and rates, relation to mechanisms
   b. Temperature and rate, activation energy, catalysis
5. Nuclear Chemistry
   a. Types of radioactive decay, writing and balancing nuclear reactions
   b. Kinetics and half life
   c. Mass-energy relationships, fission and fusion, binding energy, nuclear stability
   d. Radiation effects
6. Bonding and Structure
   a. VSEPR (Valence Shell Electron Pair Repulsion)
   b. Valence Bond Theory, hybridization, multiple bonds, resonance
   c. Bonding and properties of selected organic compounds
   d. Molecular Orbital Theory of diatomic molecules, extension to polyatomic molecules
   e. Descriptive Chemistry
7. Transition Metals
   a. Descriptive chemistry and physical properties of transition metals
   b. Nomenclature, isomerization, color, and magnetism of coordination compounds, crystal field theory
   c. Coordination Chemistry
8. Introduction to Organic Chemistry
   a. Functional groups and families
   b. Nomenclature of selected organic molecules

Laboratory or Activity Content

1. Study of Weak Acids and Weak Bases
   a. Indicators and reference standards used to predict the pH of unknown solutions
   b. pH of several acid and base solutions are determined using pH meter
   c. K_a of acetic acid is calculated by measuring pH of the weak acid solution
   d. K_a of unknown acid is calculated by measuring pH of the weak acid solution
2. Volumetric Analysis Using Potentiometric Titrations
   a. Concentration of HCl solution is determined using pH probe with computer interface
   b. Titration data of pH versus volume is plotted to obtain concentration of HCl. Titration data of pH versus volume is plotted to obtain concentration and K_a for acetic acid.
   c. Titration data of pH versus volume is plotted to obtain concentration and K_{a1} and K_{a2} for phosphoric acid
3. Determination of Ksp (Solubility Product) for $Ca(OH)_2$
   a. Saturated solutions of $Ca(OH)_2$ are prepared and filtered
   b. Mass of undissolved $Ca(OH)_2$ is determined
   c. pH of saturated $Ca(OH)_2$ solution is measured
   d. K_{sp} for $Ca(OH)_2$ is calculated using pH and using mass solubility
4. Thermodynamics Investigated
   a. Temperature changes caused by reactions of MgO + HCl and Mg + HCl are determined using a temperature probe with computer interface when temperature versus time is plotted
   b. Heats of reactions are calculated and using Hess' Law the heat formation for MgO is determined
5. Spectrophotometric Determinations
   a. Wavelength scans are prepared for solutions of red and yellow dyes using a spectrophotometer
   b. Wavelengths of maximal absorbance for the dyes are used to prepare standard curves
   c. Solutions containing unknown concentrations of the red and yellow dyes are analyzed and absorbances measured
   d. Concentrations of yellow and red dyes in an unknown solution are calculated based on measured data
6. Electrochemistry

a. Batteries are constructed using redox reactions, voltmeter, beakers, and a porous cup
b. Cell potentials are measured experimentally and calculated using a standard reduction potentials (SRP) table
c. Effect of concentration on cell potential is analyzed

7. Rates of Chemical Reactions - Kinetics
   a. Reaction rates are determined by varying concentration then plotting moles of reactant versus time
   b. Moles of reactant are determined by timing a secondary reaction that involves a color change
   c. Rate law is determined from varying concentration values and corresponding rates
   d. Rate constant for reaction is evaluated
8. Qualitative analysis
   a. Techniques of qualitative analysis are learned
   b. Reactions of anions are studied then results applied to determine cations in an unknown
   c. Reactions of group I cations are studied then results applied to determine cations in an unknown
   d. Reactions of group II cations are studied then results applied to determine cations in an unknown
   e. Reactions of group III cations are studied then results applied to determine cations in an unknown
   f. Reactions of groups IV and V cations are studied then results applied to determine cations in an unknown
   g. Unknown solution containing a mixture of cations from groups I - V are analyzed using data and qualitative analysis techniques

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Problem solving exercises
Skills demonstrations
Written expression

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Essay exams
Essays
Laboratory activities
Laboratory reports
Objective exams
Oral presentations
Projects
Problem-Solving Assignments
Problem-solving exams
Quizzes
Reports/papers
Skill tests

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Computer-aided presentations
Collaborative group work
Class activities
Class discussions
Distance Education
Demonstrations
Field trips
Group discussions
Internet research
Laboratory activities
Lecture

Describe specific examples of the methods the instructor will use:

1. The instructor will use audio-visual instruction including powerpoint presentations, videos and chalkboard/white board lectures and include Zoom meetings, asynchronous video or in-person lectures. An example of concepts included in lecture involve acid/base neutralization of weak acids and strong bases along with the mathematical approach to evaluate the neutralization/titration process using pH.

2. Instructor will incorporate group discussions and other class activities to allow students to participate in active learning. The instructor will be available for questions and clarification of chemistry concepts as students participate in group activities.
3. The instructor will require laboratory activities and give demonstrations that teach laboratory technique and how to apply concepts from the lectures. Experiments are typically in-person activities. However, use of audio-visual techniques and computer-aided simulations and presentations will also be used to illustrate and underscore the important concepts from lecture.
4. The instructor will have students titrate a solution of phosphoric acid with a standard sodium hydroxide solution of known concentration. The data (pH and volume of base) will be collected and analyzed via computer. Based on the titration graph produced by the student, the student will then determine the concentration and equilibrium constants, K_{a1} and K_{a2}, of phosphoric acid.

Representative Course Assignments

Writing Assignments

1. Students answer the questions at the end of each chapter related with the calculation of equilibrium constant in weak acid/base solution, buffer solution, enthalpy, free energy.
2. Students write essays to describe the construction of battery or the topic of chemical equilibrium.
3. Students enter the data collected in the lab period, and give the explanation of the rate law. Students are required to write a formal lab report related to Beer's Law.

Critical Thinking Assignments

1. Students are asked to analyze the results of their experiment. For example, in the titration experiments, students must understand how to utilize the information from any point on the graph to obtain the equilibrium constant of a weak acid.
2. Students must be able to find and/or calculate true values to their experiments given available textbook and internet resources. They then need to compare their values with the true values and suggest causes that explain the differences between their experimental values from the true values.
3. Students are asked to identify cations present in an unknown mixture based on their observations of experiments carried out on reference solutions.

Reading Assignments

1. Textbook and Lab Manual
2. Professional Journals; such as, Journal of Chemical and Engineering News, published by America Chemical Society.
3. Internet; such as, www.acs.org (http://www.acs.org), http://ocw.mit.edu/OcwWeb/Chemistry/, www.chemweb.com (http://www.chemweb.com), www.anytimetutor.com (http://www.anytimetutor.com)

Skills Demonstrations

1. Laboratory technique is demonstrated when students carry out acid/base titrations and must calculate their concentrations to a precision of 1/10000.
2. Safety protocols are tested and demonstrated in the lab during each experiment.

Other assignments (if applicable)

1. Encourage students to form a study group and work together to solve the equilibrium problems.
2. Help students individually in instructor's office to encourage critical thinking related to fission and fusion and their utilization as energy supplies.
3. Discuss with students via email, CANVAS or other electronic media how to do calculations involving bond order based on molecular orbital and energy level diagram.

Outside Assignments

Representative Outside Assignments

1. Students must read the textbook and lab manual
2. Students are asked to read professional journals; such as, Journal of Chemical and Engineering News, published by America Chemical Society.
3. Students must be able to determine and read appropriate reference materials (e.g. CRC, Merck Handbook, Safety Data Sheets) to obtain information needed for homework and lab preparation.
4. Students must access the internet to read additional reference material. Examples include www.acs.org (http://www.acs.org), http://ocw.mit.edu/OcwWeb/Chemistry/, www.chemweb.com (http://www.chemweb.com), www.anytimetutor.com. (http://www.anytimetutor.com)
5. Students answer the questions at the end of each chapter related with the calculation of equilibrium constant in weak acid/base solution, buffer solution, enthalpy, free energy.
6. Students complete additional assignments that are given as handouts.

7. Students write essays to describe the construction of battery or the topic of chemical equilibrium.
8. Students enter the data collected in the lab period, and give the explanation of the rate law. Students are required to write a formal lab report related to Beer's Law.
9. Students are asked to analyze the results of their experiment. For example, in the titration experiments, students must understand how to utilize the information from any point on the graph to obtain the equilibrium constant of a weak acid.
10. Students must be able to find and/or calculate true values to their experiments given available textbook and internet resources. They then need to compare their values with the true values and suggest causes that explain the differences between their experimental values from the true values.

Articulation

C-ID Descriptor Number
CHEM 120S

Status
Approved

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSUCI	CHEM 122	General Chemistry II	4

Comparable Courses within the VCCCD
CHEM M01B - General Chemistry II

District General Education

A. Natural Sciences

A2. Physical Science
Approved

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable
Yes

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

B1 Physical Science
Approved

B3 Laboratory Activity
Approved

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

Area F: Ethnic Studies

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

UC TCA

UC TCA
Approved

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 5A: Physical Science
Approved

Area 5C: Laboratory Science
Approved

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Tro, Nivaldo (2020). Chemistry: A Molecular Approach, 5th edition
Copyright by Pearson Education, Inc.
Published by Prentice Hall
Upper Saddle River, New Jersey

Resource Type
Manual

Description
Crockett, L (2018). *Chem R122 Laboratory Manual* (Revised).
Oxnard College, Oxnard

Resource Type
Other Instructional Materials

Description
Required: Scientific calculator.

Resource Type
Other Instructional Materials

Description
Required: Duplicated lab notebook.

Resource Type
Other Instructional Materials

Description
Required: Goggles.

Distance Education Addendum

Definitions

Distance Education Modalities
Hybrid (51%–99% online)
Hybrid (1%–50% online)
100% online

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.
Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.
Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Regular discussions between students via discussion boards or other collaborative tools, such as Google Docs and CANVAS
Other DE (e.g., recorded lectures)	Instructors may choose to record video lectures and presentations. They may also use preexisting video or other digital material.
Synchronous Dialog (e.g., online chat)	Instructors may choose to provide online chat room conference times
Video Conferencing	Instructors may choose to provide online video conference times

Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Synchronous Dialog (e.g., online chat)	Instructors may choose to provide online chat room conference times
Asynchronous Dialog (e.g., discussion board)	Regular discussions between students via discussion boards or other collaborative tools, such as Google Docs and CANVAS
Other DE (e.g., recorded lectures)	Instructors may choose to record video lectures and presentations. They may also use preexisting video or other digital material.
Video Conferencing	Instructors may choose to provide online video conference times

100% online Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Synchronous Dialog (e.g., online chat)	Instructors may choose to provide online chat room conference times
Asynchronous Dialog (e.g., discussion board)	Regular discussions between students via discussion boards or other collaborative tools, such as Google Docs and CANVAS
Other DE (e.g., recorded lectures)	Instructors may choose to record video lectures and presentations. They may also use preexisting video or other digital material.
Video Conferencing	Instructors may choose to provide online video conference times

Examinations

Hybrid (1%–50% online) Modality
Online
On campus

Hybrid (51%–99% online) Modality
Online
On campus

Primary Minimum Qualification
CHEMISTRY

Review and Approval Dates

Department Chair
09/02/2020

Dean
09/02/2020

Technical Review
09/09/2020

Curriculum Committee
09/09/2020

DTRW-I
MM/DD/YYYY

Curriculum Committee
11/25/2020

Board
MM/DD/YYYY

CCCCO
MM/DD/YYYY

Control Number
CCC000140955

DOE/accreditation approval date
MM/DD/YYYY