# Washtenaw Community College Comprehensive Report

# CEM 122 General Chemistry II
# Effective Term: Winter 2024

## Course Cover

**College:** Math, Science and Engineering Tech
**Division:** Math, Science and Engineering Tech
**Department:** Chemistry
**Discipline:** Chemistry
**Course Number:** 122
**Org Number:** 12320
**Full Course Title:** General Chemistry II
**Transcript Title:** General Chemistry II
**Is Consultation with other department(s) required:** No
**Publish in the Following:** College Catalog , Time Schedule , Web Page
**Reason for Submission:** Three Year Review / Assessment Report
**Change Information:**
**Objectives/Evaluation**
**Rationale:** Minor course changes.
**Proposed Start Semester:** Fall 2023
**Course Description:** In this course, students will explore the concepts of chemical kinetics, chemical equilibrium, chemical thermodynamics and electrochemistry. They will apply the scientific process of collecting and recording data to calculate and analyze lab results as well as draw conclusions. The ability to solve mathematical equations involving logarithms and exponentials is essential for success in this course. This course is the second of a two-course sequence in general chemistry for pre-professional and liberal arts students.

## Course Credit Hours

**Variable hours:** No
**Credits:** 4
**Lecture Hours: Instructor:** 45 **Student:** 45
**Lab: Instructor:** 45 **Student:** 45
**Clinical: Instructor:** 0 **Student:** 0

**Total Contact Hours: Instructor:** 90 **Student:** 90
**Repeatable for Credit:** NO
**Grading Methods:** Letter Grades
Audit
**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

## College-Level Reading and Writing

College-level Reading & Writing

## College-Level Math

No Level Required

## Requisites

**Prerequisite**
CEM 111 minimum grade "C"

(within past 5 years)
and
**Prerequisite**
MTH 176 minimum grade "C"

## General Education

**MACRAO**
MACRAO Science & Math
MACRAO Lab Science Course
**General Education Area 4 - Natural Science**
Assoc in Applied Sci - Area 4
Assoc in Science - Area 4
Assoc in Arts - Area 4
**Michigan Transfer Agreement - MTA**
MTA Lab Science

## Request Course Transfer

**Proposed For:**
Eastern Michigan University
Ferris State University
Grand Valley State University
Jackson Community College
Lawrence Tech
Michigan State University
Oakland University
University of Detroit - Mercy
University of Michigan
Wayne State University
Western Michigan University

## Student Learning Outcomes

1. Recognize the concepts and principles of general chemistry relating to chemical kinetics, chemical equilibrium, chemical thermodynamics and electrochemistry.
   **Assessment 1**
   Assessment Tool: Outcome-related departmental exam questions
   Assessment Date: Fall 2025
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 75% of students will score 70% or higher.
   Who will score and analyze the data: Full-time Chemistry faculty

2. Apply the appropriate concepts or principles of chemistry to solve kinetics, equilibrium, thermodynamics and electrochemistry problems.
   **Assessment 1**
   Assessment Tool: Outcome-related departmental exam questions
   Assessment Date: Fall 2025
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Answer key
   Standard of success to be used for this assessment: 75% of students will score 70% or higher.

Who will score and analyze the data: Full-time Chemistry faculty

**Assessment 2**

Assessment Tool: Outcome-related problem requiring calculations
Assessment Date: Fall 2025
Assessment Cycle: Every Three Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Departmentally-developed rubric
Standard of success to be used for this assessment: 75% of students will score 70% or higher.
Who will score and analyze the data: Full-time Chemistry faculty

3. Demonstrate the science processes of collecting and properly recording data, calculating and analyzing results, and drawing conclusions based on results.

**Assessment 1**

Assessment Tool: Outcome-related lab reports
Assessment Date: Fall 2025
Assessment Cycle: Every Three Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Departmentally-developed lab report rubric
Standard of success to be used for this assessment: 75% of students will score 70% or higher.
Who will score and analyze the data: Full-time Chemistry faculty

## Course Objectives

1. Define the rate of a chemical reaction. Given appropriate data, calculate the rate of reaction.
2. Identify the factors which influence the rate of a reaction.
3. Determine the rate law for a reaction from appropriate data.
4. Use the appropriate integrated rate equation to calculate reactant or product concentrations at various times.
5. Apply collision theory to a chemical reaction to explain how various factors affect the reaction rate.
6. Define activation energy. Calculate the activation energy for a reaction from appropriate data.
7. Define the mechanism of a reaction. Given a mechanism, predict the rate law for the reaction.
8. Define the equilibrium state for a chemical reaction.
9. Recognize that chemical reactions always proceed toward equilibrium.
10. Write the equilibrium constant expression for a chemical reaction at equilibrium.
11. For a chemical reaction at equilibrium, calculate the concentrations of all species present from the appropriate data.
12. Use the quadratic equation to solve for the equilibrium concentrations of reactants and products.
13. Use Le Chatelier's principle to predict the direction of shift in a chemical reaction displaced from equilibrium.
14. Define acids and bases. Predict how changes in structural features will influence the strength of an acid.
15. Write chemical equations for acid-base reactions (equilibria) that occur in aqueous solution.
16. For an acid or base solution, calculate its pH and the concentrations of all species present from the appropriate data.
17. Define a buffer and its buffering capacity. Write chemical reactions that show how a given buffer maintains its pH.
18. Calculate the pH of a buffer from the appropriate data.
19. Follow the progress of an acid-base reaction in terms of pH, and sketch its titration curve. Calculate the pH at any point during the titration.
20. Write chemical equations for equilibrium dissociation reactions that occur for ionic substances in aqueous solution.
21. Predict whether a precipitate will form given the appropriate data.
22. Calculate the solubility of a compound in pure water and in the presence of a common ion given the appropriate data.

23. Use Lewis acid-base concepts to describe complex ion formation.
24. Predict the effect of change in pH, presence of a common ion, and complex ion formation on solubility.
25. Recognize a chemical reaction as a thermodynamic system.
26. Define internal energy, enthalpy, entropy and Gibbs free energy.
27. Apply the three laws of thermodynamics to a chemical reaction.
28. Given the appropriate data, calculate the change in internal energy, enthalpy, entropy, and Gibbs free energy as a chemical reaction proceeds from reactants to products.
29. Recognize driving forces for a chemical reaction.
30. Identify the thermodynamic criteria for a spontaneous chemical reaction.
31. Identify the thermodynamic criteria for a chemical reaction at equilibrium.
32. Given the appropriate thermodynamic data, calculate the equilibrium constant for a chemical reaction.
33. Define the terms oxidation and reduction.
34. Balance chemical equations for redox reactions occurring in acid or in base.
35. Determine which species act as the oxidizing and reducing agents in a redox reaction.
36. Distinguish between a voltaic and an electrolytic cell.
37. Sketch a voltaic cell and identify its parts.
38. Use the Table of Standard Reduction Potentials to calculate standard cell potential.
39. Use the Nernst equation and appropriate concentration data to calculate the cell potential.
40. Recognize that a cell at equilibrium has a potential equal to zero.
41. Calculate the value of an equilibrium constant from cell potential data.
42. Use Faraday's law to calculate either the amount of electricity that passes through a cell or the amount of chemical change produced.
43. Observe laboratory safety procedures.
44. Keep a laboratory journal.
45. Interpret and follow written procedures.
46. Manipulate laboratory equipment to make measurements.
47. Make observations and collect data.
48. Interpret and summarize data, and calculate results.
49. Apply significant figures to measurements, calculations and data analysis.
50. Draw conclusions based on experimental results.

## New Resources for Course

## Course Textbooks/Resources

Textbooks

Flowers, P., Theopold, K., Langley, R., Robinson, W.. *Chemistry*, 2 ed. Open Stax, 2019, ISBN: 1-947172-61-1.

Gilbert, T. R., Kirss, R. V., Foster, N. and Davies, G. *Chemistry, The Science In Context (Customized for WCC)*, 4th ed. New York: W. W. Norton & Company, 2015

Manuals

Periodicals

Software

## Equipment/Facilities

Level III classroom

Testing Center

Computer workstations/lab

Data projector/computer

Other: Laboratory with data projector and computer; MicroLab data acquisition hardware and software; Laptops

| Reviewer | Action | Date |
|---|---|---|

| | | |
|---|---|---|
| **Faculty Preparer:** | | |
| *Eric Schwab* | *Faculty Preparer* | *Apr 28, 2023* |
| **Department Chair/Area Director:** | | |
| *Breege Concannon* | *Recommend Approval* | *Apr 28, 2023* |
| **Dean:** | | |
| *Tracy Schwab* | *Recommend Approval* | *May 08, 2023* |
| **Curriculum Committee Chair:** | | |
| *Randy Van Wagnen* | *Recommend Approval* | *Aug 23, 2023* |
| **Assessment Committee Chair:** | | |
| *Jessica Hale* | *Recommend Approval* | *Aug 24, 2023* |
| **Vice President for Instruction:** | | |
| *Victor Vega* | *Approve* | *Aug 30, 2023* |

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**Publish in the Following:** College Catalog , Time Schedule , Web Page
**Reason for Submission:** Three Year Review / Assessment Report
**Change Information:**
**Course description**
**Objectives/Evaluation**
**Rationale:** Change objectives to align with other chemistry courses.
**Proposed Start Semester:** Fall 2021
**Course Description:** This course is the second of a two-course sequence in general chemistry for pre-professional and liberal arts students. In this course, students will explore the concepts of chemical kinetics, chemical equilibrium, chemical thermodynamics and electrochemistry. They will apply the scientific process of collecting and recording data to calculate and analyze lab results as well as draw conclusions. The ability to solve mathematical equations involving logarithms and exponentials is essential for success in this course.

## Course Credit Hours

**Variable hours:** No
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(within past 5 years)
and
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MACRAO Science & Math
MACRAO Lab Science Course
**General Education Area 4 - Natural Science**
Assoc in Applied Sci - Area 4
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## Request Course Transfer

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Western Michigan University

## Student Learning Outcomes

1. Recognize the concepts and principles of general chemistry relating to chemical kinetics, chemical equilibrium, chemical thermodynamics and electrochemistry.
   **Assessment 1**
   Assessment Tool: Outcome-related departmental exam questions
   Assessment Date: Winter 2024
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Departmental exam multiple-choice questions will be scored against an answer key.
   Standard of success to be used for this assessment: 75% of students will score 70% or higher on the outcome-related questions.
   Who will score and analyze the data: The full-time Chemistry faculty will score the artifacts and analyze the data.

2. Apply the appropriate concepts or principles of chemistry to solve kinetics, equilibrium, thermodynamics and electrochemistry problems.
   **Assessment 1**
   Assessment Tool: Outcome-related departmental exam questions
   Assessment Date: Winter 2024
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections

Number students to be assessed: All students
How the assessment will be scored: Departmental exam multiple-choice questions that require problem-solving with calculations will be scored against an answer key.
Standard of success to be used for this assessment: 75% of students will score 70% or higher on the outcome-related questions.
Who will score and analyze the data: The full-time Chemistry faculty will score the artifacts and analyze the data.

**Assessment 2**

Assessment Tool: Problem to be solved requiring that calculations be shown
Assessment Date: Winter 2024
Assessment Cycle: Every Three Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: A departmentally-developed rubric will be used to score and evaluate the calculations used to solve the posed problem.
Standard of success to be used for this assessment: 75% of students will score 70% or higher on the scoring rubric.
Who will score and analyze the data: Full-time Chemistry faculty will score and analyze the data.

3. Demonstrate the science processes of collecting and properly recording data, calculating and analyzing results, and drawing conclusions based on results.

**Assessment 1**

Assessment Tool: Lab reports
Assessment Date: Winter 2024
Assessment Cycle: Every Three Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Lab reports from a selected experiment will be scored against a departmentally-developed lab report rubric.
Standard of success to be used for this assessment: 75% of students will score 70% or higher on the lab report rubric.
Who will score and analyze the data: The full-time chemistry faculty will score the artifacts and analyze the data.

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Manuals

Periodicals

Software

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Other: Laboratory with data projector and computer; MicroLab data acquisition hardware and software; Laptops

| Reviewer | Action | Date |
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| **Faculty Preparer:** | | |
| *Eric Schwab* | *Faculty Preparer* | *Aug 17, 2021* |
| **Department Chair/Area Director:** | | |
| *Tracy Schwab* | *Recommend Approval* | *Aug 18, 2021* |
| **Dean:** | | |
| *Victor Vega* | *Recommend Approval* | *Aug 26, 2021* |
| **Curriculum Committee Chair:** | | |
| *Randy Van Wagnen* | *Recommend Approval* | *Nov 12, 2021* |
| **Assessment Committee Chair:** | | |
| *Shawn Deron* | *Recommend Approval* | *Nov 13, 2021* |
| **Vice President for Instruction:** | | |
| *Kimberly Hurns* | *Approve* | *Nov 15, 2021* |