

University of Wisconsin-Madison
Chemistry 329-2 (Choi)
Fundamentals of Analytical Science
Spring 2018

Instructor: Prof. Kyoung-Shin Choi
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(Please include "Chem 329" in the subject line.)
Office hours: WF 12:00-12:30 or by appointment
Course webpage: <https://learnuw.wisc.edu>

Credit hours: CHEM 329 is a 4-credit class that meets each week for two 50-minute lectures, one 50-minute discussion, and two 4-hour laboratories. Over the course of the semester, students are expected to do at least 180 hours of learning activities, which includes class attendance, reading, studying, preparation, problem sets, laboratory reports, and other learning activities.

Instructional mode: Face-to-face
Lecture: MW 11:00 – 11:50 AM in Chem B371
Lab: TR 1:20 -5:25 PM in MSC 5360 & 5385
Discussion: F 11:00-11:50 AM in Chem B287, 2307, 2377, or 2323 Sterling Hall (depending on your section assignment)

Lab Director: Dr. Pamela Doolittle
Office: SMI 535
Phone: 2-9679
E-mail: pam.doolittle@wisc.edu
Office hours: Dr. Doolittle has an "open door" policy for meeting students. Feel free to stop by her office, email, call, or make an appointment when seeking help related to the laboratory portion of this course.

Teaching Assistants:

| | | |
|-----------------|-----------------|--|
| Section 331/631 | Matt Hautzinger | hautzinger@wisc.edu |
| Section 322/622 | Paige Kinsley | kinsley2@wisc.edu |
| Section 333/633 | Taylor Evans | tevans4@wisc.edu |
| Section 334/634 | Blaise Thompson | bthompson4@wisc.edu |

Course Description: Chemistry 329 is an intermediate level analytical chemistry course. Content emphasizes the fundamentals of chemical measurement in chemistry, biology, engineering, geology, and the medical sciences. Topics include equilibria of complex systems, spectroscopy, electrochemistry, separations, and quantitative laboratory technique.

Requisites: Chem 104 or 109 or consent of instructor

Course Designations: Intermediate level; physical science breadth; counts as L&S credit

Learning Objectives for Chem 329:

Students will be able to

- a) Apply the statistical methods for the evaluation of laboratory data
- b) Use calibration and sampling methods important to quantitative analysis
- c) Model chemical systems and experimental data using relevant quantitative, mathematical, and computational methods.
- d) Learn analytical methods based on titrations, separations, electrochemical measurements, and spectroscopy and interpret the results for chemical analysis
- e) Identify, formulate, and solve integrative problems using appropriate information and approaches.
- f) Develop skills in working collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge.
- g) Communicate chemical knowledge effectively through written reports, oral presentations, and visual aids.
- h) Locate, evaluate, and use information in the chemical literature.

Textbook: Harris, Daniel C. *“Quantitative Chemical Analysis”* 8th Ed.

Lab Manual: *A Manual of Experiments for Analytical Chemistry – Spring 2018*, Department of Chemistry, UW- Madison. Lab manuals will be sold in Chemistry room 1371 beginning Tuesday, January 23. WiscCard purchase only—NO CASH SALES.

Lab Notebook: Carbonless laboratory notebook with numbered, duplicate pages. Alpha Chi Sigma (AXE), a professional co-ed chemistry fraternity founded here at UW-Madison, will be selling suitable lab notebooks in CHEM 1371.

Calculator: A scientific or graphing calculator is required. Only calculators that are permitted on SAT or ACT tests may be used on exams. You may NOT use any stored information, programs, or applications on exams unless given explicit permission.

Personal Protection Equipment (PPE): Industrial quality eye protection is required at all times when you are in the lab. Indirectly vented safety goggles that completely seal around the eyes and fit over regular glasses can either be purchased from local bookstores or from Alpha Chi Sigma in CHEM 1371. You're also required to wear a laboratory coat at all times in lab; lab coats will be available for WiscCard purchase in CHEM 1371 if you need one. You should transport your lab coat in a sealed plastic bag, such as a 1 gallon Ziploc. **Students requiring special accommodations in lab should contact the laboratory director, Dr. Pam Doolittle, before the first lab meets.**

USB Drive: A USB flash drive that will hold at least 2 GB is required for laboratory.

Grades: The point distribution is as follows:

| | | | |
|---------------|-----------------------------|---|------------------|
| Exams: | 3 exams x 150 pts | = | 450 pts. |
| Homework: | 9 assignments x 20 pts | = | 180 pts. |
| Laboratory: | labs (12 x 14 pts) | | |
| | pre-lab quizzes (12x 6 pts) | | |
| | project (95 pts) | | |
| | lab exit survey (5 pts) | | |
| | lab total | = | 340 pts. |
| TA evaluation | | = | 30 pts. |
| <i>Total:</i> | | = | <i>1000 pts.</i> |

The intended grading scale is:

| | |
|-----|----------|
| A | 890-1000 |
| A/B | 840-889 |
| B | 790-839 |
| B/C | 740-789 |
| C | 680-739 |
| D | 600-679 |
| F | <599 |

However, the scale may be shifted to reflect overall class performance. You will be updated changes to the scale twice during the semester.

Exams: There will be three exams, each counting equally towards the final grade. The first two exams will be given during the scheduled laboratory period, and the third will be given at the time scheduled by the university during the final week. The exams are not cumulative, but will nonetheless draw upon knowledge gained during previous parts of the course. **No make-up exams will be given.** Students who have a university-approved event that conflicts with the exams may arrange to take an **early exam after consulting with Prof. Choi in advance.**

| | |
|-----------|--|
| Exam I: | March 1, Thursday 3-5 PM (6 th week) |
| Exam II: | April 5, Thursday 3-5 PM (10 th week) |
| Exam III: | May 6, Sunday, 10:05 AM to 12:05 PM |

Homework: Regular problem sets will be assigned on Tuesdays and will be due the following Tuesday (hand in to your TA in lab **before the lab session starts.** **No late assignments are accepted. This is a strict deadline.** You may work on these assignments as a group, but you must turn in your own homework. Be sure to note that the homework assignments directly reflect exam material. If you cannot work out the problems yourself after the completion of the homework, you will not gain the *proficiency* required to solve the problems on the exams within the timeframe of the exams. Homework is graded based on completion and not on the correct answer. Explain your thinking and show your work to receive full credit. It's your responsibility to check the key to determine if your answer is correct. TAs will direct your thinking, but they may not detail where you went wrong. If you're having trouble completing homework, or have questions, contact Professor Choi, your TA, or Dr. Doolittle for help.

Course Outline:

The tentative course schedule is as follows:

| Week | Lecture Topics | Book Chapters | HW |
|----------------------|--------------------------------------|----------------------|-----------|
| 1 (Jan 24 -Wed) | Intro | 0, 1 | |
| 2 (Jan 29) | Units, Errors | 3, 4 | |
| 3 (Feb 5) | Statistics | 4 | 1 |
| 4 (Feb 12) | Equilibria, Acid-base | 6, 8 | 2 |
| 5 (Feb 19) | Acid-base | 8, 9 | 3 |
| 6 (Feb 26) (Exam I) | Acid-base titrations | 10 | |
| 7 (Mar 5) | Acid-base titrations | 10 | 4 |
| 8 (Mar 12) | Activity, EDTA | 7, 11 | 5 |
| 9 (Mar 19) | Redox, Electrochemistry | 13, 15 | 6 |
| 10 (Apr 2) (Exam II) | Electrochemistry, Project Intro | 14, 16 | |
| 11 (Apr 9) | Electrochemistry | 14, 16 | 7 |
| 12 (Apr 16) | Spectrophotometry | 17, 18 | 8 |
| 13 (Apr 23) | Spectrophotometry, Chromatography | 19, 22 | 9 |
| 14 (Apr 30) | Chromatography | 23, 24, 25 | |

This schedule will change as we go along, depending on how we do in these lectures. You should also note that textbook chapters 0, 2, and 27 are devoted to analytical laboratory practices. Although you will not be directly tested on these chapters, you may find information in these chapters that will boost your performance in the laboratory.

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Any cases of academic misconduct will be reported to the Office of Student Conduct & Community Standards. For more information, refer to:

studentconduct.wiscweb.wisc.edu/academic-integrity/

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional

accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.”

DIVERSITY & INCLUSION

Institutional statement on diversity: “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” <https://diversity.wisc.edu/>

What to do if you must miss a class

Your attendance at all scheduled classes (lecture, discussion, and lab) is mandatory and essential for success in the course. However, circumstances occasionally occur where a student must miss a class. The best way to handle an absence depends somewhat on the particular situation. Below are some guidelines.

Planned absences from classes

Students sometimes need to miss class for a religious observance, a UW athletic commitment, graduate school interview or some other legitimate reason. These are *planned* absences and any arrangements for making up missed work must be made *before* the absence occurs. Otherwise, the absence will be unexcused and you will receive a zero on the missed work. In general, homework should be turned in early (before the deadline) if you will be absent on the day it is due.

Missing class because of illness

Students should usually attend classes if they have a minor illness, such as the common cold or a headache that is not a migraine. If you are vomiting or have flu-like symptoms (fever of 100 °F/37.8 °C or higher with cough or sore throat) you should stay home until you are well. For flu-like illnesses, you should be fever-free without fever-reducing medication for 24 hours. This means you should not attend classes, work, or extracurricular activities. *You should inform your TA of your illness via email promptly, as soon as you know you will be missing class.*

Homework

If you need an extension on your homework because of illness, you need to make arrangements with the professor *before* the homework due date. Depending on your circumstances, I will consider an extension without penalty. Late homework cannot be accepted once the answer key is posted.

Missed lab

Labs are very difficult to make up. Your TA (with assistance from Dr. Doolittle, the lab director) will advise you on the best way to get caught up. In some cases you might be able to catch up by using spare time in subsequent labs. Lab absences will be handled on a case-by-case basis and accommodations will only be made if lab is missed for a legitimate reason.

Missed lecture

TA lecture notes, slides from lecture, and homework assignments will all be posted on the Content page of the course website. I recommend that you also borrow notes from a classmate. Make sure you check in with your TA and/or a classmate for any announcements you might have missed.

If you are well enough, you should try keeping up by studying the text and lecture notes and working on the homework problems. Of course, how much you are able to do will depend on the severity of your symptoms. Getting plenty of rest, lots of fluids, etc., is the top priority. You will be back in action much sooner if you take good care of yourself! But keeping up with your classes might provide some relief to the boredom of not being able to go anywhere.

Keep your TA informed

Email your TA again when you expect to return to classes. The sooner you notify your TA about your expected return, the easier it will be to make any needed accommodations.

Laboratory:

The laboratory counts for a total of 34% towards your final grade and is divided into three main categories: standard experiments, lab quizzes, and project.

- There will be 12 graded standard experiments, and your grade will be based on the accuracy and precision of your results. **The results from these experiments are to be turned in no later than the start of the laboratory period following the completion of the experiment.** You will lose 4 pts/day if the result is turned in late.
- The primary goal of the pre-lab quizzes is to prompt you to prepare for the labs beforehand and to test your knowledge and understanding of the concepts behind the standard experiments. Overall, being “prepared” for a lab means you are familiar with the: overall concepts and goals of the experiment, methods used in the experiment to accomplish the goals, procedure (enough so that you understand the impact of each step on the chemistry and the calculations, e.g. dilutions, stoichiometry, etc), and calculations (enough so that you understand how to perform the calculation required for the experiment given a set of raw data). You can have two attempts at each quiz, the higher grade will be the final grade. It is advised that you make your first attempt for each quiz at least 1 day before the lab so that you have time to ask questions before your second attempt, in case you encounter any difficulties. **The quiz for each lab becomes unavailable when that lab starts.**
- The lab project could be the most challenging and also most rewarding part of this course. We will discuss the project in more details as we go into the semester.

| Week | Date | 631 Matt Hautzinger | 632 Paige Kinsley | 633 Taylor Evans | 634 Blaise Thompson |
|------|--------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|
| 1 | 23-Jan | <i>No lab</i> | | | |
| | 25-Jan | Check-in/Weighing | Check-in/Weighing | Check-in/Weighing | Check-in/Weighing |
| 2 | 30-Jan | Volumetric Apparatus | Volumetric Apparatus | Volumetric Apparatus | Volumetric Apparatus |
| | 1-Feb | Standardization of HCl | Standardization of HCl | Standardization of HCl | Standardization of HCl |
| 3 | 6-Feb | Standardization of NaOH | Standardization of NaOH | Standardization of NaOH | Standardization of NaOH |
| | 8-Feb | Determination of % KHP | Determination of % KHP | Determination of % KHP | Determination of % KHP |
| 4 | 13-Feb | Calcium as Oxalate | Calcium as Oxalate | Calcium as Oxalate | Calcium as Oxalate |
| | 15-Feb | Adventures with Buffers | Adventures with Buffers | Adventures with Buffers | Adventures with Buffers |
| 5 | 20-Feb | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid |
| | 22-Feb | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid |
| 6 | 27-Feb | Study Day/Lab Make-up | Study Day/Lab Make-up | Study Day/Lab Make-up | Study Day/Lab Make-up |
| | 1-Mar | <i>Exam 1</i> | | | |
| 7 | 6-Mar | Bromocresol Green | Bromocresol Green | Bromocresol Green | Bromocresol Green |
| | 8-Mar | Hardness of Water | Chemical Oxygen Demand | Hardness of Water | Chemical Oxygen Demand |
| 8 | 13-Mar | Chemical Oxygen Demand | Hardness of Water | Chemical Oxygen Demand | Hardness of Water |
| | 15-Mar | Fluoride ISE | Silver Electrode Study | Fluoride ISE | Silver Electrode Study |
| 9 | 20-Mar | Silver Electrode Study | Fluoride ISE | Silver Electrode Study | Fluoride ISE |
| | 22-Mar | Lab Make-up Day | Lab Make-up Day | Lab Make-up Day | Lab Make-up Day |
| -- | 27-Mar | <i>Spring Break</i> | | | |
| | 29-Mar | <i>Spring Break</i> | | | |
| 10 | 3-Apr | Project Planning Day | Project Planning Day | Project Planning Day | Project Planning Day |
| | 5-Apr | <i>Exam 2</i> | | | |
| 11 | 10-Apr | Project | Project | Project | Project |
| | 12-Apr | Project | Project | Project | Project |
| 12 | 17-Apr | Project | Project | Project | Project |
| | 19-Apr | Project | Project | Project | Project |
| 13 | 24-Apr | Project | Project | Project | Project |
| | 26-Apr | Spectrophotometric Det. Of Fe | Spectrophotometric Det. Of Fe | Spectrophotometric Det. Of Fe | Spectrophotometric Det. Of Fe |
| 14 | 1-May | <i>Project Presentation</i> | <i>Project Presentation</i> | Spectroscopic Det. Of a Mixture | Spectroscopic Det. Of a Mixture |
| | 3-May | Spectroscopic Det. Mixture/Check-out | Spectroscopic Det. Mixture/Check-out | <i>Project Presentation/Check-out</i> | <i>Project Presentation/Check-out</i> |