WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Syllabus

CHEM 115 (Chemical Principles I)

Fall Semester, 2019

Credits: 5 credits (course hours are met via the traditional Carnegie definition).

Course Designation and Attributes: *Breadth - Physical Sci. Counts toward the Natural Sci req; Level – Elementary*; *L&S Credit - Counts as Liberal Arts and Science credit in L&S*; *Honors - Accelerated Honors*

Meeting Time and Location: MWF 8:50-9:40 AM, Chemistry 2311

Instructional Mode: The course will be taught in-person, with additional course materials provide on line.

Chemistry 115 is the 5-credit, first course of a two-semester honors sequence focusing on fundamental chemical principles. It is designed for very well prepared and highly motivated students with a strong interest in science or engineering. The course is quite mathematical, and presumes a sound background in chemistry, physics, and calculus. We will explore a detailed atomic and molecular view of matter and its interactions. Topics include quantum theory, molecular structure and bonding, kinetic theory of gases, and descriptions of liquids, solids, and phase transitions. Chemistry 116, the second course of the sequence, treats thermodynamics, chemical and physical equilibrium, electrochemistry, acid-base chemistry, solubility, chemical kinetics, and spectroscopy.

Course Learning Outcomes:

- Apply a qualitative understanding of quantum mechanics to fundamental chemical concepts, including the structure of the atom and molecular bonding
- Solve elementary eigenvalue problems, including the "particle in a box" and "harmonic oscillator"
- Utilize the basic tenants of the kinetic theory of gases to describe the properties of gases
- Describe the structures of solids and liquids

Instructor: J.R. Schmidt, 8305d Chemistry, 262-2996, *schmidt@chem.wisc.edu*.

Lab Director*:* Dr. Pamela Doolittle, 535 SMI, 262-9679, *pam@chem.wisc.edu*.

Instructor Office Hour: Thursday afternoon, 12:30 – 1:30 pm, 8305d Chem. Or by appointment.

Teaching Assistant: Mr. Patrick Sullivan. EMAIL: ptsullivan@wisc.edu Room 1201 Chemistry, desk #00.

TA Office Hour: Thursdays from 2-3 PM

Primary Text: D.W. Oxtoby, H.P. Gillis, and A. Campion, Principles of Modern Chemistry, 6th edition, Thomson Brooks/Cole, 2008. (This can be found online as a .pdf download.)

Other Required Materials: (1) Lab notebook (on sale in Chemistry 1375, first week of classes). (2) Industrial quality safety goggles for lab work (purchased at bookstore). (3) A scientific calculator. If you have a smartphone, there is likely an app!

Lectures: MWF 8:50-9:40 am, 2311 Chemistry. *The lectures and discussion sections are an integral part of the class.* Attendance is essential! You should take your own notes. To a first approximation, we will follow Chapters 1-10 and 21 in the text, but at a higher level.

Web Page: *Learn@UW* has a Chem 115 site where I will post problem sets, exam and problem set answer keys, reading assignments, etc. You can log in at: *https://learnuw.wisc.edu/*.

Problem Sets: Weekly, usually assigned Monday and due the following Monday before class. *Late papers will not be accepted!!!* Show your work! Solutions will be posted on *Learn@UW*. *We encourage you to discuss the problems together, but you must hand in*

and take responsibility for your own solutions. And you will take the exams alone!

Discussion Section: These are devoted to review of recent lecture material, the background for upcoming labs, and general problem solving. Your TA is in charge of content. Section 591 meets Tuesdays, 8:50-9:40 am, Room 2377 Chem. Section 592 meets Mondays, 3:30-4:20 pm, Room 2381 Chem.

Examinations: Three in-class exams during the semester. *Likely dates*: Friday, October 11, Monday, November 11, and Friday, December 6. *Final exam:* Thursday, December 19, 7:45 am – 9:45 am. The exams will focus on the lecture material, but questions about the labs are possible. No make-up exams will be given. The final exam will be comprehensive.

Literature Research Topic and Oral Presentation: A research paper is due at the beginning of class on Monday, November 25. The paper should be 8-10 pages long (about 2500 words) and should describe a modern research topic related to the Chem 115 course material (broadly defined). Please include the relevant citations. You should begin looking for a topic that interests you. Your topic needs the professor's approval on or before Friday, October 25. You will also give a short oral Powerpoint presentation briefly summarizing your topic in the lab sections during the week of December 2 (or the following week).

Grading: Problems sets (100 points), Exam I (100), Exam II (100), Exam III (100), Final Exam (200), Research paper (100), oral presentation (100), Laboratory (200). Course grades based on the class distribution of total points; no absolute grading scale.

Math comment: All of you have had some calculus, but many of you have not seen multi-variable calculus. We will learn the math as we need it.

Questions: Please feel free to interrupt the lecture to ask questions. It helps me to sharpen my thinking and to better understand how things are going "out there".

Laboratory**:** Lab Section 891 meets Thursdays, 7:45-10:45 am, Room 5360 Medical Sciences Center. Lab Section 892 meets Wednesdays, 2:25-5:25 pm, Room 5360 Medical Sciences Center. See the schedule that follows. In all laboratory periods in which you work with chemicals you are required to wear safety goggles and shoes with closed toes (not sandals). Your TA will supervise the laboratories and direct your work. She will discuss related material, demonstrate unfamiliar techniques, and answer questions. The goal of the laboratory is to provide experience with a variety of techniques and to illustrate the principles we are discussing in lecture. We especially want you to learn to generate accurate and precise quantitative results and to interpret them critically. You must come to the laboratory prepared, having read and understood the procedure, and completed a statement of the objective of the experiment in your notebook. Your TA will give you more detailed instructions for the pre - laboratory assignments. You must keep a laboratory notebook providing a detailed record of your primary data, as described in the manual, and you must prepare a report for each laboratory. The style and detail of the laboratory reports will vary with the experiments. *You must complete the laboratory to pass the course.*

University of Wisconsin
Chemistry 115 – Chemical Principles I (Schmidt)
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Laboratory Schedule

	Scheduled Experiment
Week 1 (9/2)	Check-in/Series of Reactions
Week 2 (9/9)	Synthesis of Cu-Ammine Compounds
Week 3 (9/16)	Synthesis of Cu-Ammine Compounds—Day 2
Week 4 (9/23)	*Literature Searches—(Ariel Andrea)*
Week 5 (9/30)	Propagation of Error
Week 6 (10/7)	Crystal Violet*
Week 7 (10/14)	*Computer Activity: Potential Wells and the Hydrogen Atom*
Week 8 (10/21)	Atomic Emission*
Week 9 (10/28)	*Computer Activity: Molecular Orbitals*
Week 10 (11/4)	Spectrophotometric Determination of Fe/Measuring Fe in Cereal
Week 11 (11/11)	Nine Solutions
Week 12 (11/19)	Window on the Solid State (online activity) Neutron Activation Energy of $Silver^{+}$
Week 13 (11/26)	No Lab
Week 14 (12/3)	Solid State Structures and Properties Optical Diffraction *Check Out*
Week 15 (12/11)	*Presentations***

Lab is scheduled for Thursday from 7:45 AM to 10:45 AM in MSC room 5360 for section 891 and Wednesday from 2:25 PM – 5:25 PM in MSC room 5360 for section 892.

*Laboratory report should be submitted as a formal paper.
+Labs this week will be on Monday afternoon and Tuesday morning. Contact your TA if you have a conflict. Some of this lab can be done online.
**A schedule for presentations will be announced prior to week 15.

Entries in italics do not require lab attire for performing experimental work.