Course Description (from the Bulletin): This is the second semester of the 1-year Chemistry 105/106 course sequence, which is specifically designed to meet the needs of science majors and preprofessional students. Topics covered in Chemistry 106 include: molecular structure, chemistry of metals and selected nonmetals, intermolecular forces, chemical equilibrium.

Prerequisites: Chemistry 105 with a grade of (C) or better and either completion of Math 104 with a grade of C or better, or completion/placement in any higher math course.

Class meetings (weekly): 3 hr lecture (8 – 9:30 A T&Th in HS-106); 1 hr discussion; 3 hr 20 min lab (5 credits total). Meeting times vary depending upon the section to which you are assigned (See the Course Schedule on pages 10 – 12).

Attendance policy: Students are expected to attend all of their scheduled class sessions. Students will be excused for illness, quarantine, family emergencies, and required University sanctioned activities. If you know about an absence ahead of time it may be possible to arrange an alternative time to make up any missed assignments. Please e-mail your instructors to arrange to make up assignments missed because of an excused absence.

Lecture instructor (course coordinator) contact information:

Sections: A09C (lecture), A01D, A02D, A05L, A08L	Dr. Jonathan Gutow	Halsey 412	424-1326	gutow@uwosh.edu

Additional discussion and lab instructor contact information:

Sections (D = discussion, L = Lab)	Instructor	Office	Phone #	Email Address
A04D, A08D	Dr. Michael Foley	Halsey 440	424-1314	foleym@uwosh.edu
A04L	Dr. Brant Kedrowski	Halsey 446	424-3488	kedrowsk@uwosh.edu
A01L, A02L	Dr. Sheri Lense	Halsey 414	424-3476	lenses@uwosh.edu
A05D	Dr. Lauren Waters	Halsey 409	424-7099	watersl@uwosh.edu

Office hours: Any of the instructors in this course are happy to meet with you to answer questions related to the course, discuss study strategies, academics, your goals, or life in general. All have regularly scheduled ‘drop-in’ office hours that will be posted in the course Canvas site. If you cannot make scheduled office hours, you can arrange an appointment by contacting the instructor you wish to meet.

Required course materials:

- *Textbook*: Chemistry: Atoms First 2e, Flowers et al. OpenStax. This textbook can be read online or downloaded as a pdf for free or purchased as a printed copy from the bookstore.
- *Lab Manual*: Chemistry 106 Lab Manual S24, Gutow. Available from the bookstore.

- *Online Homework*: ALEKS for general chemistry, McGraw-Hill, 1 semester access code required. Detailed instructions for registration provided separately.
- *Response System*: Registration with the PointSolutions (aka Turning and Echo 360) system. You can use a smartphone or purchase a response clicker. Detailed instructions for registration provided separately.
- *Goggles*: Indirect vented safety goggles (must bear the number Z87.1) are required. Available at the bookstore or from the UW Oshkosh Chemistry Club (sold at the Chemistry Stockroom HS-450). **No goggles? No lab!**
- *Calculator*: Any make with scientific notation, powers, roots, and logarithms. A graphing calculator is not necessary. Cell phones and other internet-enabled devices will not be allowed as calculators on tests and quizzes.

Course Objectives and Learning Outcomes

CHEM 106 General Chemistry II is an Explore/Nature course (XL) in the University Studies Program. The course meets chemistry requirements for students majoring in science or engineering, or in secondary education with a natural science emphasis, as well as for students preparing for healthcare programs including chiropracty, dentistry, medicine, nursing, pharmacy, physical therapy, and veterinary medicine.

As part of a liberal arts curriculum this course has a number of goals. The primary goal is to introduce students to the language and the elementary theories of chemistry, to provide training and practice in analytical reasoning and problem solving, and to serve as the basis for further studies in the sciences. This fits well into the liberal arts curriculum because it teaches skills which are generally useful and specific models that are widely applicable. Learning to use these models is extremely good practice for solving unfamiliar problems as well as thinking analytically, critically and creatively. A few of the things these models are used for are understanding the chemical reactions involved in living, the shapes of biomolecules, environmental issues such as climate change, developing new drugs, energy sources and designing solid-state electronics. After taking this course you should be able to:

1. Still do all the things described in the objectives and learning outcomes from General Chemistry I (Chem 105).
2. Use the mathematical concepts of chemical kinetics combined with symbolic (text based) representations of chemical reactions to explain observed reaction rates and predict changing concentrations during a reaction.
3. Use detailed theories of reaction mechanisms to explain the dependence of reaction rates on concentrations, temperature and catalysts.
4. Use models of intermolecular interactions to explain solubilities, dissolution, electrolytes and colloids.
5. Use the quantitative models of colligative properties to estimate physical properties of solutions and solutes.
6. Use quantitative and qualitative models to explain and model equilibria of chemical reactions.

7. Apply the concepts of chemical equilibria to quantitatively model equilibria of acids and bases (Brønsted-Lowry and Lewis), of salt hydrolysis, of buffers, of precipitation, of dissolution, and of redox reactions.
8. Use the connections between free energy, equilibrium constants and cell potentials to understand conditions that encourage corrosion and how galvanic cells (in the vernacular "batteries") behave.
9. Describe the basic categories of useful "batteries" and be familiar with some of the current directions of research aimed at improving them.
10. Describe the structure of coordination compounds, including isomers, and explain why and how they exhibit particular spectroscopic and magnetic properties.
11. Describe some of the important uses for transition metal compounds.
12. Work cooperatively with others to critically analyze abstract and physical (laboratory) problems, as well as accurately record observations and data.

Course Components and Studying Suggestions

Each week you will have at least five ways to learn chemistry. Success in this fast-paced and challenging course requires good attendance and a significant investment of time in addition to scheduled class hours. Remember that this is a 5 credit course, so will require almost twice as much work as a 3 credit course. **Be prepared to spend <u>at least</u> 10 hours outside of class each week working on Chem 106 materials.** Students are more successful when they spread the work out, spending 1 – 2 hours during each of 5 or 6 days a week. Learning later material depends on understanding earlier material, so it is important to keep up. Ask questions as soon as you have them, in class or during office hours. If office hours do not work with your schedule make an appointment. Please come see your course instructors to clear up points of confusion or to explore topics beyond the scope of the class or textbook. The five opportunities to learn the course material and some thoughts on how to use them to learn the material are expanded on below.

Reading/Studying:

Research on successful students shows that they do more than just the required homework. You should spend additional time reading the text, reviewing and annotating your notes, getting additional help on topics you do not understand, learning vocabulary, etc. Key things that will make your studying more effective are:

1. Before each class read the textbook sections on the material to be covered. Write down important terms and ideas to help you become familiar with key vocabulary, making it easier to take notes during class. Try in-chapter example problems as you read.
2. Start the relevant homework before the material is covered in class.
3. Write down any questions you have after doing the first two steps. If your question are not answered during class, please ask them.

Some other study/review techniques that may help you: write down or record an audio summary of important ideas from a particular lecture or section of the course; teach material to a friend (this is one of the best ways to figure out if you really understand it); convert your lecture and reading notes to questions and answers to use on flash cards to quiz yourself; rewrite your notes from lecture or reading in your own words. Even more ideas on studying and aligning your studying with your preferences may be found on Dr. G's website at: https://cms.gutow.uwosh.edu/Gutow/classes/general-study-hints.

Homework:

You will get credit for work completed in ALEKS. ALEKS is an intelligent tutoring system that will help you efficiently practice chemistry problem solving. ALEKS will not make you work on topics you already know, but will require you to practice topics until you can reliably solve related problems. When you start using ALEKS you will take an adaptive quiz called an Initial Knowledge Check to determine what you already know/understand. Take this Initial Knowledge Check seriously so that you do not have to work on exercises for topics you have already mastered prior to this course. Based on your performance, ALEKS may assign you some review exercises, so you will be ready for the course material.

The ALEKS homework will be due twice a week. Each assignment is called a module and consists of a number of topics to learn. Access to the next module starts as soon as you complete the previous one. The material for each module is too difficult to learn in one large chunk the night the module is due. You should plan to work on ALEKS homework most days of the week. Plan on spending 4 – 8 hours spread throughout each week working in ALEKS. We suggest you break ALEKS work up into 20 – 40 minute blocks depending on available time and stamina.

Some objectives will be followed by Knowledge Checks. These will quiz you on topics you have already learned, to see if you have forgot any. ALEKS will help you review for the exams by adding any topics you have forgot back into your learning path. Topics that the Knowledge Check determines you have remembered are added to your list of mastered topics.

Open Pie periods allow you to work on any topic for which you have learned the prerequisite topics. Open Pie is a good time to go back to old topics you have not completed or to work ahead. Open Pie periods are scheduled most Fridays through Noon on Saturday. If you finish a module early you will also enter an Open Pie period.

There is also a review option that lets you practice topics you have mastered.

50% of your ALEKS grade is determined by the fraction of topics you learn by each module deadline. 30% of your ALEKS grade is determined by the fraction of all the topics you learn (in your "pie") by the end of the semester. 20% of your ALEKS grade is determined by the fraction of all the topics you master by the end of the semester. Therefore, it is to your advantage to take all Knowledge Checks and to continue working on topics you have not learned even after the topic due date has passed.

In addition to the required ALEKS homework you may find the end-of-chapter problems in the text useful additional practice for topics you want to work on more. Specific problems may be suggested in the weekly summary provided in the course Canvas site. Answers are provided in an appendix of the text.

Discussion:

Discussion sections provide an opportunity to reinforce lecture material in a smaller group setting. Class time will be spent working in small groups on exercises provided by the instructor. Occasionally, new material will be presented, which will not be re-covered in lecture, but will be on the exams and homework. Credit for Discussion will be based on participation. Attendance and honest effort on the in-class exercises will earn a 100% for the day. When the answer key for the discussion exercises become available, you should check your discussion work and make sure you understand all the material. If you have questions ask them of an instructor as soon as possible.

Lecture:

Lectures meet Tuesdays and Thursdays in HS – 106 from 8 – 9:30 A. In lecture you will listen to descriptions of important concepts, take notes, ask questions and use the response system to participate in interactive exercises. Make sure to bring your calculator and phone/clicker to each lecture. After lecture you should:

1. Attempt related homework. Initially, this can be done consulting the textbook, lecture notes and other resources (e.g. ALEKS explanations) and you may want to work with fellow students. An important additional step, especially for quantitative problems, is that after you figure out how to solve a particular type you should practice working on them independently using only your calculator, a list of relevant formulas and necessary tables of data. On Knowledge checks ALEKS will encourage you to do the problems this way.
2. Review your lecture notes. If they are unclear or have errors try to correct them using the textbook. Write down questions for anything you are unable to fix. Consult classmates or your instructors to get answers to your questions.

Laboratory:

“Hands-on” laboratory work is an essential part of chemistry. In the lab you will experience directly some of the relationships discussed in the lecture, learn experimental techniques, and solve chemical problems. You will learn to use scientific instruments, and make careful observations. Bring your lab manual, goggles, and calculator to the laboratory. The chemistry laboratory can be a dangerous place. A strict dress code and other safety regulations will be enforced. See the lab manual for further details.

**Anyone who is pregnant or has a history of serious allergies MUST inform their laboratory instructor BEFORE entering the lab to do any work.

Peer Educator Sessions (optional):

A peer educator, a student who has successfully completed Chem 105 and 106, will offer optional problem-solving sessions. Times will be announced in class and provided in the course Canvas site. Many past students have found this useful. You are encouraged to incorporate these sessions into your study strategy.

Tutoring (optional):

The UW Oshkosh Center for Academic Resources offers free, confidential tutoring to all UWO students. CAR is located in the Student Success Center, suite 102. Check their website www.uwosh.edu/car for more information or to contact a tutor. Many students have used this in the past and found it extremely helpful!

Accommodations:

The University of Wisconsin Oshkosh supports the right of all enrolled students to a full and equal educational opportunity. It is the University's policy to provide reasonable accommodations to students who have documented disabilities that may affect their ability to participate in course activities or to meet course requirements. Students are expected to inform instructors of the need for accommodations as soon as possible by presenting an Accommodation Plan from either the Accessibility Center, Project Success, or both. Reasonable accommodations for students with disabilities is a shared instructor and student responsibility. The Accessibility Center is part of the Dean of Students Office and is located in 125 Dempsey Hall. For more information, email accessibilitycenter@uwosh.edu, call 920-424-3100, or visit the Accessibility Center Website.

Grading

Attendance: Regular attendance is essential to successfully passing the course. An unexcused absence during a scheduled laboratory, discussion or exam will result in a zero-point score for that laboratory, discussion or exam. **There are no makeups for exams**.

The reason for any **excused** absence from an exam, discussion, or laboratory session must be presented to your instructor (in advance if possible). Assignments and tests missed for a valid reason will not be counted against you, but you will be responsible for material covered in your absence. Advance notice of a pending absence will often make it possible to arrange for an alternate time for an exam or attendance in another lab or discussion section.

- **If you have two or more unexcused absences from lab or get less that 50% in the laboratory part of the course you will receive a grade of F, no matter what your overall score is.**
- **If you miss more than one exam for any reason, you will receive an incomplete or a failing grade depending on the circumstances.**

Grade Calculation:

Exams (4 exams)	52%
ALEKS Homework	15%
Discussion (participation, two lowest dropped)	.10%
Lecture Response Questions (1 pt ea up to 30 pts, >50 pts available)	.3%
Laboratory	20%
Total	100%

Grading Scale
The minimum percentage necessary for each grade range is listed below. These cutoffs will not be adjusted upward, but the instructor reserves the right to lower them.

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Minimum %	91	88	83	79	74	70	66	62	58	54	52	0

Grades will be posted in Canvas as they become available, so you may check your current course grade at any time during the semester. It is your responsibility to verify that all scores are entered properly. Misgraded assignments or exams must be returned to your instructor for possible regrading no later than one week following their return to you. You are responsible for checking that your final score is correct. Save all work until the final course grade has been determined.

Laboratory Grade
Laboratory work is completed in small groups to assist students in gaining teamwork and leadership skills. Points are earned through pre-lab assignments (Canvas quizzes due by 8A on day lab meets) and short laboratory reports (generally completed during lab).

Attendance in laboratory is mandatory. Two unexcused absences from lab or a score of less than 50% in the laboratory component will result in a failing grade for this course, regardless of exam scores. If you miss a lab, you may attend another lab during the same week, if space allows. To attend another lab session, you must verify the switch with both your normal lab instructor and the instructor of the lab you will attend. Do not expect laboratory experiences to directly correlate with concurrent lecture topics.

Online Homework (ALEKS) Grade
The overall ALEKS grade will be calculated as: 20% for fraction of mastery of topics by the end of the semester; 30% for the fraction of topics learned (pie progress) by the end of the semester and 50% for fraction of topics completed by assigned deadlines.

Response System Questions Grade
You will receive one point for each question answered correctly; up to a maximum of 30 (at least 50 will be asked over the course of the semester).

Exam Grading, Schedule and Policies
Exams will be primarily multiple choice with no partial credit. Each exam will contain questions on material covered in the weeks preceding the exam. Much of the material in the class is cumulative, and you will need to use material tested on earlier exams to answer more sophisticated questions asked on later exams. Additionally, core topics from earlier exams will be reviewed on later exams. More information on the core topics can be found at the end of the syllabus.

Bring your own calculator for all exams. Exams 1-3 and Exam 4 Part A will 90 minutes each. You will take the exam during your scheduled class time unless special arrangements are made with the instructor ahead of time. Exam 4 Part B (core topics) will be administered in HS-402 during your laboratory meeting time the last week of the semester.

Dates, times, and information for the 90-minute exams:

	During Class Time	Number of Questions
Exam 1	Tuesday, Feb. 27	35 (30 new material + 5 Chem 105 core topics)
Exam 2	Thursday, Mar. 21	35 (30 new material + 5 core topics)
Exam 3	Tuesday, Apr. 23	35 (30 new material + 5 core topics)
Exam 4 Part A	Thursday, May 16	30 (all new material)
Exam 4 Part B	During scheduled lab time (May 13 – 17)	20 (all core topics primarily from Chem 106)

All exam questions are weighted equally. The computer scan sheets for multiple choice exams will not be returned to you. Make sure that you record your answers on the exam as well as the scan sheet. You must check the posted answer keys to verify that your score was entered properly.

No radios, MP3 players, headsets or other recording or transmitting devices may be used during exams. Caps with bills must have bills turned to back of head.

Early exams will be offered for students who cannot attend the exam at the scheduled time. Students who need to take an early exam must sign up with the instructor the week before the exam.

Course policies

Classroom Decorum:

Be courteous to your fellow classmates. While pertinent questions are encouraged, talking and whispering during lecture are disruptive and annoying to nearby students trying to listen to the lecture.

Cell Phones must be silenced and put away except when using them to respond to in-class questions. This means absolutely no “texting” during class.

Computers may be used to take notes, but do not use them for e-mail, videos, game playing, etc. during class as it is disruptive and annoying to nearby classmates trying to listen to the lecture.

E-mail etiquette:

Your instructors will happily respond to your emails as fast as they can. Please be sure to include “CHEM 106:” at the beginning of your subject line, so that we know what the email is referring to. In the body include as much information as you can provide about what you are asking, and your name. Instructors will try to answer e-mails within 1 business day. If an instructor does not reply within 1 business day, there is a chance that they missed your e-mail, so please forward the e-mail again. We do not respond to e-mails that include “text speak”.

Academic Misconduct:

The University of Wisconsin-Oshkosh is built upon a strong foundation of integrity, respect, and trust. All members of the university community have a responsibility to be honest and the right to expect honesty from others. Any form of academic dishonesty is unacceptable to our community and will not be tolerated.

As college students (and adults) you are expected to observe high standards of integrity and honesty. Representing the work of another as your own is considered academic misconduct. Any assignment (exams) which you are required to do individually should contain only your own work. Students caught cheating on exams, quizzes, or in the laboratory are subject to a grade of F for the assignment and a report being placed in their academic records. A second offense is likely to result in expulsion from the University. For more details see the information on the Dean of Students Office website and the portions of Wisconsin State Law referenced there.

Grading Errors:

To be considered for possible regrading any mistakes must be brought to the attention of your instructor within one week of the time the exam, quiz or project is returned to you.

Final Grade Check:

You are responsible for checking that your final score is correct. Save all papers, exams and quizzes until the final course grade has been determined.

Other Useful Information

RESPECTING THE DIVERSITY OF OUR COMMUNITY: Diversity drives innovation, creativity, and progress. At the University of Wisconsin Oshkosh, the culture, identities, life experiences, unique abilities, and talents of every individual contribute to the foundation of our success. Creating and maintaining an inclusive and equitable environment is of paramount importance to us. This pursuit prepares all of us to be global citizens who will contribute to the betterment of the world. We are committed to a university culture that provides everyone with the opportunity to thrive. Therefore, all members of our community are expected to treat each other with respect and apply intellectually rigorous critical analysis to all their interactions with others (e.g. activities, discussions, arguments, etc...).

STUDENTS RIGHT TO KNOW ACT OF 1990: Students are advised to see the following URL for disclosures about essential consumer protection items required by the Students Right to Know Act of 1990: https://uwosh.edu/financialaid/consumer-information/.

THERE ARE LOTS OF SUPPORT SERVICES ON CAMPUS: If you have an emergency, mental health issue, suffer harassment, have food insecurity, …, see the campus resources information in the class Canvas site.

Course Schedule

Lecture meeting times: Tuesdays and Thursdays 8:00 – 9:30 AM in Halsey Science Room 106

Discussion meeting times:

Section	Instructor	Location	Wednesdays	Section	Instructor	Location	Wednesdays
A01D	Dr. Gutow	HS 456	10:20-11:20	A04D	Dr. Foley	HS 456	1:50-2:50
A02D	Dr. Gutow	HS 456	11:30 -12:30	A05D	Dr. Waters	HS 456	3 – 4
A08D	Dr. Foley	HS 456	12:40 – 1:40				

Lab meeting times (all meet in HS 402): Labs do not meet the week of February 5, 2024. Exam 4 Part B will be administered during your lab section the week of May 13, 2024.

Monday	Tuesday	Wednesday	Thursday
9:10 A-12:30 A A08L/Gutow	9:40 A–1:00 P A01L/Lense		9:40 A-1:00 P A02L/Lense
1:50 P -5:10 P A05L/Gutow	1:20 – 4:30 P A04L/Kedrowski		

Important Dates

- ALEKS Initial Knowledge Check due before completing the ALEKS prerequisite review (due Thursday, February 8th). To allow time to work on the prerequisite review try to complete the Knowledge Check by Tuesday, February 6th.
- First labs meet week of Monday, February 12th.
- Exam Dates:

Tuesday, Feb. 27
Thursday, Mar. 21
Tuesday, Apr. 23
Thursday, May 16
In Lab during the week of May 13.

- Last date to drop this course without a Late Add/Drop Request Form: Wednesday, March 20, 2024. Students dropping the course must check out of lab before the drop is considered complete.

Topics List:
This summarizes the topics in the reading you should do before class and before attempting the associated homework. See the class schedule/calendar for the expected dates topics will be addressed in class.

Week Beginning	Topics (numbers are sections to read in OpenStax text)
Feb. 5	**17.1 – 17.3:** Reaction Rates, Things that Change Rates, Rate Laws
Feb. 12	**17.3 – 17.5:** Rate Laws, Integrated Rate Laws, Collision Theory, Arrhenius Equation
Feb. 19	**17.6 – 17.7:** Reaction Mechanisms, Catalysis **11.1 – 11.2:** Dissolution, Electrolytes
Feb. 26	Exam 1 **11.3 – 11.4:** (not on Exam 1) Solubility of Gases and Liquids, Colligative Properties
Mar. 4	**11.5:** Colloids **13.1 – 13.3[a]:** Chemical Equilibria, Equilibrium Constants (skipping K_p), Le Châtelier's Principle
Mar. 11	**13.4:** Equilibrium Calculations **14.1 – 14.3:** Brønsted-Lowry Acids and Bases, pH, pOH, Acid and Base Strengths
Mar. 18	**14.3:** Acid and Base Strengths, K_a, K_b, Acid-Base Equilibria Exam 2
Mar. 25	SPRING BREAK
Apr. 1	**14.4 – 14.7:** Hydrolysis of Salts, Polyprotic Acids, Buffers, Acid-Base Titrations
Apr. 8	**15.1 – 15.2**: Precipitation and Dissolution Equilibria, Lewis Acids and Bases
Apr. 15	**16.1 – 16.4**: Balancing Redox, Galvanic (Voltaic) Cells, Cell Potentials, Potential versus ΔG and K_{eq}
Apr. 22	Exam 3 **16.6 –16.7:** (not on Exam 3) Corrosion, Electrolysis
Apr. 29	**16.5, Recent Battery Technology:** Batteries, Fuel Cells, Flow Cells, Solid-State Cells **19.1 – 19.2:** Transition Metals, Transition Metal Compounds, Coordination Chemistry
May 6	**19.2 – 19.3[b]:** Coordination Chemistry, Spectroscopic and Magnetic Properties of Coordination Compounds
May 13	**19.3[b]:** Spectroscopic and Magnetic Properties of Coordination Compounds Exam 4 & Core Topics Exam

[a] (Sec 13.2) K_p values and related conversions will be skipped. [b] If time allows we will talk a little about the formation of organic condensation and addition polymers, plus some special properties of these very large molecules.

TENTATIVE SCHEDULE (*Bold face #'s are related reading in OpenStax text)*

Week Beginning	ALEKS (Monday)	Lectures (Tuesday)	Discussion (Wednesday)	Lectures (Thursday)	ALEKS (Thursday)	Lab (Days vary)
Feb. 5	Initial Knowledge Check	**17.1 – 17.2**	**17.1, 17.3**	**17.2 – 17.3**	Prerequisite Review	No Lab
Feb. 12	Mod 1	**17.3 – 17.4**	**17.4**	**17.4 - 17.5**	Mod 2 open pie starts	Prelab due Check-in, Safety, Bath Bombs
Feb. 19	Mod 3	**17.6 – 17.7, 11.1**	**17.6 – 17.7**	**11.1 – 11.2** *Review*	Mod 4 open pie starts	Prelab due Dye Bleaching
Feb. 26	Mod 5 *Knowl. Check Due Tuesday*	EXAM 1 *(through 11.2)*	**11.3 – 11.4**	***11.3 – 11.4***	Mod 6 open pie starts	Prelab due Colligative Properties
Mar. 4	Mod 7	**11.5, 13.1**	**13.2**[a]	**13.1 – 13.4**[a]	Mod 8 open pie starts	Prelab due Le Châtelier's Principle
Mar. 11	Mod 9	**13.4**	**13.4**	***14.1 – 14.3***	Mod 10 open pie starts	Prelab due Equilibrium Constants
Mar. 18	Mod 11 (**Due Tuesday**) *Knowl. Check due Wednesday*	**14.3**	*review*	EXAM 2 *(through 14.3)*	Open pie over spring break (through March 30)	Prelab due Diprotic Acids
Mar. 25	SPRING BREAK					
Apr. 1	Mod 12 (**Due Tuesday**)	**14.4 – 14.5**	**14.4 – 14.6**	**14.6 – 14.7**	Mod 13 open pie starts	Prelab due Buffers
Apr. 8	Mod 14	**15.1 – 15.2**	**15.1 – 15.2**	**15.1 – 15.2**	Mod 15 open pie starts	Prelab due Differential solubility
Apr. 15	Mod 16 (**Due Tuesday**)	**16.1 – 16.2**	**16.2 – 16.3**	**16.3 –16.4** *review*	Mod 17 open pie starts	Prelab due Electrochemistry
Apr. 22	Mod 18 *Knowl. Check Due Tuesday*	EXAM 3 *(through 16.4)*	**16.7**	**16.7, 16.6**	Mod 19 open pie starts	Prelab due Electroplating
Apr. 29	Mod 20	**16.5, Recent Battery Technology**	**16.6 – 16.7**	**19.1 – 19.2**	Mod 21 open pie starts	Prelab due Synthesis of Prussian Blue
May 6	Mod 22	**19.2 – 19.3**	**19.2 – 19.3**	**19.2 –19.3**[b]	Mod 23 open pie starts	Prelab due Spectrochemical Series Checkout
May 13	Mod 24 *Knowl. Check Due Tuesday*	**19.3**[b] *Review*	*Review*	EXAM 4	Open pie continues until 5/19	Exam 4 Part B Core Topics Exam

[a] (Sec 13.2) K_p values and related conversions will be skipped. [b] If time allows we will talk a little about the formation of organic condensation and addition polymers, plus some special properties of these very large molecules.

Core Topics

The topics and skills listed below are fundamental to being able to use the material in this class in courses for which it is a prerequisite, in related areas such as biology and healthcare, and understanding how the physical world around you behaves. This is not a complete list of all the material you will learn about in this course. However, because they are important scaffolding for this and future courses, you will be tested on them repeatedly throughout this course.

Exam 1 will have a random selection of 5 core topic questions from Chem 105. Exams 2, 3 and 4 will contain questions reviewing core topics that were learned for previous exams primarily in Chem 106. This will allow you to get credit for learning the topic later than the exam for which it was covered in class. Exam 4 will be in two parts: the first part will cover the new material since exam 3; the second part will have questions related to all the topics on this list, allowing you to earn credit for learning any core topics you missed earlier in the class.

Covered in Chem 105:

1. Use the periodic table to find information about an element's atomic structure and number of valence electrons.
2. Based on chemical formula, determine if a compound is ionic or covalent.
3. Starting with formula, determine charges in ionic compound.
4. Know the formulas and charges of common polyatomic ions. Recognize these in chemical compounds.
5. Know the formulas and names of common strong acids and bases.
6. Know metric prefixes (mega, kilo, centi, milli, micro, nano) and calculate metric conversions (ex: milligram to kilogram).
7. Identify the number of significant figures/digits in a measurement and propagate significant figures/digits through calculations involving +, -, x and ÷.
8. Determine chemical formula from a skeletal structure.
9. Calculate molar mass based on chemical formula.
10. Interconvert mass and moles, labelling units correctly in calculation.
11. Interconvert Molarity and moles, labelling units correctly in calculation.
12. Dilution calculation (new concentration, final volume or solvent to add).
13. Write equations for acid-base and dissolution reactions.
14. Use the periodic table and oxidation number rules to assign oxidation numbers to atomic ions and elements in a compound. Note: for atomic ions the oxidation number and ionic charge are the same.
15. Balance a chemical reaction.
16. Use a chemical reaction to relate moles of reactants and products.
17. % yield calculations/limiting reagents.
18. Starting with chemical formula, draw Lewis structure.
19. Determine the hybridization and VSEPR shape from a Lewis structure.
20. Identify π and σ bonds. Groups connected by only σ bonds can rotate relative to each other.
21. Thermodynamic calculations of ΔH^{o}_{rxn}, ΔG^{o}_{rxn} and ΔS^{o}_{rxn} from thermodynamic tables.
22. Relationship of intermolecular forces to phase, viscosity and capillary rise.

Covered for exam 1:

1. Starting with a balanced chemical reaction specify the quantitative relationship among the rates of change of all species in the reaction.

2. Use the slope of concentration versus time (and approximations to it) to calculate reaction rates.
3. Given a chemical rate law deduce the overall order and order with respect to each reagent.
4. Interpret a reaction mechanism and identify the catalyst and rate determining steps, if they exist.
5. Use the concept of activation energy to predict relative reaction rates and explain how temperature impacts reaction rates.
6. Combine algebraic manipulation of quantitative models with graphical analyses of data to extract information. This is a general technique but specific examples of application include: determination of reaction order, rate constants, activation energy, etc...

Covered for exam 2:

1. Describe how gas solubility depends on pressure.
2. Describe how freezing point and boiling point depend on the quantity of solute in the liquid phase.
3. Utilize the concentration units of mole fraction and molality in calculations
4. Be able to construct a reaction quotient from a balanced chemical reaction and understand its relationship to the equilibrium constant for the reaction.
5. Apply Le Châtelier's principle to predict which way a process or reaction will proceed to reach equilibrium.
6. Determine equilibrium concentrations given a reaction's initial conditions and equilibrium constant.
7. Use pK_a and K_a to determine relative strengths of acids and bases.
8. Use the size of equilibrium constants to determine if reactants or products are favored.

Covered for exam 3:

1. Given the Henderson Hasselbach equation estimate the pH of a buffer.
2. Be able to identify Lewis acids and bases and explain how Brønsted-Lowry acids and bases are a subset of Lewis acids and bases.
3. Use cell potentials to determine the spontaneous direction of a redox reaction.
4. Given the Nernst equation and the relationship of K_{eq} to ΔG^o calculate K_{eq} and ΔG^o.

Covered for exam 4:

1. Predicting the shapes of coordination compounds using VSEPR and crystal field theory (CFT).
2. Use CFT to explain and predict whether a complex is high- or low-spin and whether it is paramagnetic or diamagnetic.