MASC 110L: Materials Science

4 Units
Fall 2024, MWF 10:00-10:50am
Location: ZHS352

Instructor: Ken-ichi Nomura

Office: VHE 609A
Office Hours: In person: TBA, Online: by appointment
Contact Info: knomura@usc.edu

Teaching Assistant: TBA

Contact Info: MASC 110L has several laboratory and discussion teaching assistants. TA contact information and office hours will be posted on Brightspace.

Course Description

MASC 110L is an introductory course intended for undergraduate engineering students. Key concepts in chemistry are discussed in the context of materials science and engineering applications. The laboratory component of the course provides students with hands-on experience, reinforcing concepts covered in lecture through direct observation and experimentation. Topics include the electronic structure of atoms, elements and the periodic table, organic and inorganic compounds, chemical reactions, kinetics and thermodynamics, the structure and properties of engineering materials, and modern topics in materials science.

Learning Objectives

Following completion of this course, students should be able to

- Place concepts from chemistry and materials science into a broader historical context and describe the importance of the underlying science to engineering applications
- Demonstrate familiarity with the organizational scheme of the periodic table, the electron structure of atoms, and the types and mechanisms of atomic bonding
- Differentiate between organic and inorganic compounds, and identify and name compounds
- Describe the difference, at the atomic/molecular level, between solids, liquids, and gasses
- Classify engineering materials as metals, ceramics, or polymers, and describe the types of elements and atomic bonds characteristic of each material type
- Predict the behavior of gas phase chemical systems using ideal gas behavior
- Use tabulated thermodynamic data to determine the spontaneity of a reaction
- Write and balance chemical equations
- Perform experiments, collect and analyze data
- Prepare lab reports in which critical information is presented concisely

Prerequisite(s): None

Recommended Preparation: High school chemistry

Course Notes

A Brightspace website for the course (https://brightspace.usc.edu/d2l/home) will be used for general announcements, assignments, course emails, and important course documents and information. Be sure to check Brightspace and your USC email regularly.

Technological Proficiency and Hardware/Software Required

A computer with internet access is required to access course materials and complete/submit assignments. Please bring a web enabled device (phone, tablet, laptop) to the lecture section of the class to respond to poll questions.

Required Materials

Textbook: *Chemistry: Principles and Reactions, Masterton and Hurley, 8th* edition **ISBN: 9781305079373**

A physical copy of the textbook is *not* required for the class. Purchase a hard copy only if you want one. An electronic version of the text will be available through Cengage website (https://www.cengage.com), and students are responsible only for material covered in lecture and discussion sections.

Online web-based learning (OWLv2)

A web-based system will be used for readings and homework assignments. **Online access to the OWL system (which includes an electronic copy of the textbook) is required for the course.** Register by clicking the "OWLv2 Registration" link in the course site on Brightspace. The first time you click through you will be guided through a series of prompts to register for access this semester.

Use your USC email and the name that you are registered under at USC when signing up. You will need to select and pay for single term access. A free trial is available if you have not yet finalized your schedule. Any assignments submitted using the trial subscription will transfer over once you pay for semester-long access.

Need help? Visit https://startstrong.cengage.com/owlv2-brightspace-ia-no for step-by-step registration instructions and videos.

Description and Assessment of Assignments

Homework

Following lecture, OWL problems will be posted online. All problems assigned throughout the week are due prior to the beginning of class of following Monday. Homework problems allow multiple attempts and include access to feedback and explanations.

Discussion Worksheets

Discussion sessions are held weekly. In discussion students will work in groups to complete a series of guided inquiry exercises. Discussion is designed to introduce new concepts as well as further clarify concepts covered in lecture. While not all questions addressed in discussion have a single correct answer, discussion work will be graded based on participation and completeness. It is expected that students arrive prepared and engage in small group discussions. The lowest discussion grade will be dropped from your final grade if you actively attend all discussions and complete the worksheets.

Lab reports

Lab reports for each experiment are due the following week, prior to the start of your scheduled lab session. Lab reports must be typed and uploaded via Gradescope (https://www.gradescope.com). A scanned copy of your original lab data sheet must be submitted with your lab report. The lowest lab report grade will be dropped from your final grade if you actively attend all labs and submit the lab reports.

Participation

Completion of lab and discussion activities requires attending and actively participating in your scheduled lab and discussion sections. If you need to miss labs or discussions because of travel, illness, etc. discuss it with course instructor and every effort will be made to provide reasonable accommodations. Attendance to lecture is not required but highly encouraged.

Grading Breakdown

Assignment	% of Grade
OWL homework assignments	15
Lab reports	15
Discussion worksheets	10
Midterm 1	20
Midterm 2	20
Final exam	20
Total	100

Grading Scale

Letter grade	Corresponding numerical point range
A	92-100
A-	90-91
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	65-69
D	60-64
D-	55-59
F	54 and below

Grading Timeline

OWLv2 assignments are graded instantaneously upon submission. Lab report grades will be posted two weeks after submission. Students can access feedback on lab reports via Gradescope. OWLv2 problems have integrated feedback and explanations.

Course Specific Policies

Homework submitted up to one week late will receive 50% credit. Homework problems are unavailable for submission one week following the due date.

Lab reports for each experiment are due the following week, prior to the start of your lab section. Reports submitted up to one week late receive 75% credit, and those submitted up to two weeks late receive 50% credit. No credit is given for lab reports submitted more than two weeks late.

AI tool usage policy

In this course, use of artificial intelligence (AI)-powered programs (such as ChatGPT) is permitted however it should be fully disclosed and properly cited in your work. You should also be aware that AI text generation tools may present incorrect information, biased responses, and incomplete analyses. To adhere to our university values, you must cite any AI-generated material (e.g., text, images, etc.) included or referenced in your report. Using an AI tool to generate content without proper attribution may be treated as plagiarism.

Course Evaluation

Course evaluation occurs at the end of the semester university-wide. The learning experience evaluation is a critical tool for instructors and the university to improve teaching. Students are asked to provide honest and constructive feedback and focus on specific aspects of instruction as opposed to personal characteristics of the instructor.

Course Schedule: Weekly Breakdown

	Topics/Daily Activities	Reading	Lab	Discussion
Week 1 8/26-8/30	Atoms, ions, and isotopes	Ch 1 (all) Ch 2 (2.1-2.3, 2.5) Ch 3 (3.1-3.2)	Lab safety Writing a lab report/Intro to Gradescope	Matter and chemical vs physical reactions
Week 2 9/2-9/6 *No class 9/2*	Electronic structure and the periodic table	Ch 2 (2.4) Ch 6 (all)	NO LAB	NO DISCUSSION
Week 3 9/9-9/13	Metallic & ionic bonding: Crystal structures	Ch 9 (9.1, 9.4-9.6)	Determination of Avogadro's number via electrodeposition	Electron configuration
Week 4 9/16-9/20	Covalent bonding: Lewis structures	Ch 2 (2.6-2.7) Ch 7 (7.1)	Atomic Spectroscopy	Ionic compounds and naming ions
Week 5: 9/23-9/27	Exceptions to the octet rule and VSEPR	Ch 7 (7.2-7.4)	Crystal structures	Molecular shape
Week 6 9/30-10/4	Hydrocarbons	Ch 22 (22.1)	Microstructure of metals	Midterm review
Week 7 10/7-10/11 *No class 10/10-10/11*	Organic compounds **MIDTERM 1 (10/9, Wed)**	Ch 22 (22.2, 22.5)	NO LAB	NO DISCUSSION
Week 8 10/14-10/18	Polymer structures	Ch 22 (22.6) Ch 23 (23.1-23.2)	Hardness characterization	Introduction to Machine Learning and computer vision model
Week 9: 10/21-10/25	Gasses and liquids	Ch 3 (3.3) Ch 5 (5.1-5.5) Ch 9 (9.1-9.2)	Polymers (macromolecules)	Balancing chemical equations and theoretical yield
Week 10 10/28-11/1	Kinetics	Ch 5 (5.6-5.7) Ch 11 (all)	Thermal reduction of copper ore to copper metal	Kinetic molecular theory and real gasses
Week 11 11/4-11/8	Equilibrium	Ch 12 (all)	Machine Learning Application in Materials Science	Midterm review
Week 12 11/11-11/15 *No class 11/11*	Equilibrium cont. Thermodynamics **MIDTERM 2 (11/15, Fri)**	Ch 8 (8.1, 8.7)	NO LAB	NO DISCUSSION
Week 13 11/18-11/22	Thermochemistry	Ch 8 (8.2-8.5) Ch 16 (all)	Calorimetry	Reaction coordinates
Week 14 11/25-11/29 *No class 11/27-11/29*	Redox reactions	Ch 4 (4.2-4.3)	NO LAB	NO DISCUSSION
Week 15 12/2-12/6	Electrochemistry	Ch 17 (17.1-17.5)	Corrosion	Final exam review

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Course Content Distribution and Synchronous Session Recordings Policies:

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. (Living our Unifying Values: The USC Student Handbook, page 13).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process

(registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.