

Chem 3130/7130 - Solid-state chemistry: materials and applications – Spring A 2024

Instructor: Dr. Luisa Whittaker-Brooks, HEB-N 4150, luisa.whittaker@utah.edu

Office Hours: Monday & Wednesday, 1:00 PM – 2:00 PM

Lecture: Monday – Wednesday – Friday, 9:35 AM – 10:40 AM, HEB 2006

Class begin: January 8 – February 28, 2024

Exam 1 (comprehensive): February 28, 2024 (9:35 AM – 10:40 AM) Room: HEB 2006

Scope and purpose: This is a descriptive course designed to introduce you to the fundamentals of solid state chemistry as well as recent applications in the area of materials chemistry.

Description: Connections among synthesis, crystal structure, characterization, electronic structure, and device fabrication of a variety of materials are developed. We will emphasize characterization of local and extended arrangements in crystalline and amorphous solids. We will end the semester by discussing “real world” applications where solid-state materials are generating impactful strides.

Textbook: **Solid State Materials Chemistry. P. M. Woodward, P. Karen, J. S. O. Evans, T. Vogt**

Solid State Materials Chemistry. An Introduction. Smart and Moore. Fourth Edition.

Basic Solid-State Chemistry. A West

Lectures on the electrical properties of materials. Solymar and Walsh

Understanding solids: The Science of Materials. R. Tilley

Reactions and characterizations of solids. S.E. Dann

Introduction to Solid State Physics. C. Kittel

Evaluation

Quiz (3)	30%
In class assignments	10%
Research assignment	20%
Exam (1)	40%
	100%

Final grades will be assigned on the following basis:

A	≥ 93.00%	B+	89.99 – 87.00%	C+	79.99 – 77.00%		
A-	92.99 – 90.00%	B	86.99 – 83.00%	C	76.99 – 73.00%	D	69.99 – 60.00%
		B-	82.99 – 80.00%	C-	72.99 – 70.00%	E	≤59.99%

Topics

Week	Topic
1 (1/8-1/12)	Chapter 1: Structures of crystalline materials
2 (1/17-1/19)	Chapter 2: Defects and more complex structures
3 (1/22-1/26)	Chapter 3: Defects chemistry and nonstoichiometry
4 (1/29-2/2)	Chapter 5: Chemical bonding
5 (2/5-2/9)	Chapter 6: Electronic band structure
6 (2/12-2/16)	Chapter 7: Optical materials
7 (2/19-2/23)	Chapter 10 and 13: Conducting materials/energy materials

Attendance

- Attendance is mandatory in CHEM 3130/7130 however no attendance records are kept. It is strongly recommended that you attend class since students who show up for lectures do better in the class.
- You should schedule all activities such as advising appointments, preregistration, Regents Examinations, etc. early in the semester so that they do not interfere with regularly scheduled assignments. Such absences are not excused.
- Assignments missed because of participation in officially scheduled University of Utah functions will be considered as excused absences. Typically, this means that we will average your other scores for the missed assignment and substitute the average score. A written statement by the sponsoring University of Utah faculty member, on University Department letterhead, must be submitted to your instructor one week prior to the function to receive an excused absence. This does *not* include club sports sponsored by Associated Students of the University of Utah.
- You are responsible for announcements made in class. Absence from class does not relieve you of this responsibility.**

Exams:

Exam 1 (comprehensive) → February 28, 2024

- The material covered on the final exam will include everything in the assigned powerpoint presentations except material that is explicitly excluded.
- To be fair to all, questions about what will be covered on the final exam will be answered in class only. No such questions will be answered by telephone or e-mail.
- The only legitimate excuses for missing your testing period are extenuating circumstances that are beyond your control. Examples of these circumstances are illness, death in the family, or car accidents on the way to take the test. Forgetting when to come take your exam or sleeping through your exam period are not legitimate excuses. Excuses must be accompanied with proper documentation. **Students that miss the final exam due to illness must bring documentation from a physician stating that they were seen in the physician's office and that they were too ill to attend the exam on that date.** Legitimate excuses must be documented within two days of the missed exam period. If you miss your exam period because of extenuating circumstances, it is your responsibility to inform your instructor in a timely fashion. Your instructor will then discuss with you appropriate measures to remedy the situation.
- Students who arrive late for the exam will be allowed to begin the exam at the time they arrive but will lose all of the time they are late on the exam.
- Exam scores are typically posted on the Canvas grade book within four school days of the last exam day. A message will be posted on the Canvas Discussion area letting everyone know when grades are posted.
- Any questions regarding credit on an exam question must be submitted in writing within two days after the grades have been posted on Canvas. Any questions regarding exam credit will not be considered after two days.

RESEARCH ASSIGNMENT

The goals of this assignment are to help you:

- Become more knowledgeable about finding and using **varied research sources** available to you.
- Further develop your **critical thinking skills** and **back up your points with evidence**.
- Become more proficient at **synthesizing information** and **developing informed views**.
- Discipline yourself to **follow a scholarly research format** to **document in-text sources** and a **reference page (bibliography)**.
- Compose a **well-organized, clear, concise, research paper** to expand your knowledge on a subject in your major.

-Research presentation **February 16, 2024**. Prepare video using zoom.

Research presentation

- Your research presentation must be a recompilation of **your own thoughts**. **Review** the University of Utah Student Code statement and guidelines.

- The research presentation is a perspective highlighting the **use of a particular instrumentation in Materials Chemistry**. Discuss how it works, what data can be obtained, and highlight 2-3 breakthroughs in the field.

- Topic: Your research presentation begins with a fact-finding search on some **current/challenges** issue in materials science to advance your knowledge. After you brainstorm about possible subjects and then select one, narrow your topic down to a manageable issue. Investigate possible approaches to your chosen topic and map out your strategy. Your final product will be judged on how well you succeed in producing a well thought out, clear paper which shows you can interpret and intelligently discuss the issue and how well you can back-up your findings with evidence.

Withdrawal Instructions

- Subject to changes in the Official University of Utah Calendar, students may drop (delete) any class without penalty during the first week of the term. The last day to drop a class without tuition penalties is Friday, February 2nd. It is possible to withdraw from the course up to Friday, November 13th, but you will still have to pay tuition for the course and a "W" will appear on your transcript. You do NOT need the instructor's signature to withdraw. After February 2nd, a student must petition for withdrawal to the Dean's office of their academic college. University policy states that withdrawals after this date should only be granted for "non-academic reasons beyond the student's control." "I want to avoid a bad grade" or similar does not qualify.
- With respect to the course content, it is the student's obligation to determine, before the last day to drop courses without penalty, when course requirements conflict with the student's sincerely-held core beliefs. If there is such a conflict, the student should consider dropping the class. A student who finds this solution impracticable may request a content accommodation from the instructor. Though the University provides, through this policy, a process by which a student may make such a request, the policy does not oblige the instructor to grant the request, except in those cases when a denial would be arbitrary and capricious or illegal. This request must be made to the instructor in writing, and the student must deliver a copy of the request to the office of the department Chair or to the office of the Dean of the College of Science. The student's request must articulate the burden the requirement would place on the student's beliefs.

Semester Start and End Dates

- First half of the Spring Semester 2024 begins on Monday, January 8th and ends on the final exam date (February 26th, 2024). Requests to miss the final exam, take it early, etc. because of vacation or other personal plans will be denied.

This course meets the Science Foundation General Education Requirement (SF)

This course is inherently useful to students since it provides them with tools to understand the world around them with a focus on solid-state materials chemistry and its applications.

A knowledge of materials chemistry is essential to understanding the great challenges facing the world in areas as diverse as energy, health care and the environment, to name a few. Discussion of these topics as examples of "applied" chemistry naturally arise in the classroom, from the text and on the web. More broadly, the course employs the scientific method as a means of acquiring and assessing knowledge and thus contributes to the critical thinking skills of our students.

Integrative thinking is required for successful problem solving in chemistry where math, matter and logic are all needed to solve quantitative problems.

The problem-solving focus that is in the DNA of this course requires critical thinking and strong reasoning skills. Student must develop the skills to analyze a problem, select what quantitative and/or qualitative tools to solve the problem determine what facts, formulas and data are needed to reach a solution.

This course will provide students with Foundations and Skills for Lifelong Learning since the problem solving skills developed in this course can be applied to real world problems. Many of the issues facing our society, including energy and the environment, can be constructively approached from a chemical perspective.

You have all chosen to be here for various academic and professional reasons.

My promise to you is that this will be a stimulating and challenging course and your hard work will pay off in enhanced problem-solving ability and increased understanding of the world around you from a chemical perspective.

I hope you will enjoy your study of chemistry – the central science.

UNIVERSITY & COURSE POLICES

Academic Code of Conduct

Students are encouraged to review the Student Code for the University of Utah: [https:// regulations.utah.edu/academics/6-400.php](https://regulations.utah.edu/academics/6-400.php). In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty, including but not limited to refraining from cheating, plagiarizing, research misconduct, misrepresenting one's work, and/or inappropriately collaborating. A student who engages in academic misconduct as defined in Part I.B. may be subject to academic sanctions including but not limited to a grade reduction, failing grade, probation, suspension or dismissal from the program or the University, or revocation of the student's degree or certificate. Sanctions may also include community service, a written reprimand, and/or a written statement of misconduct that can be put into an appropriate record maintained for purposes of the profession or discipline for which the student is preparing.

Student Mental Health Resources

- *Rates of burnout, anxiety, depression, isolation, and loneliness have noticeably increased during the pandemic. If you need help, reach out for [campus mental health resources](#), including counseling, trainings and other support.*
- *Consider participating in a [Mental Health First Aid](#) or other [wellness-themed](#) training provided by our Center for Student Wellness and sharing these opportunities with your peers, teaching assistants and department colleagues*

Inclusivity

Students from all diverse backgrounds and perspectives will be well served by this course. Students' learning needs will be addressed both in and out of class, and the diversity that students bring to this class will be viewed as a resource, strength, and benefit. Materials will be presented that are respectful of diversity: age, color, disability, gender, gender identity, gender expression, national origin, political affiliation, race, religion, sexual orientation, and veteran status, and other unique identities. Your suggestions are encouraged and appreciated. Please let us know of ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let us know so that we can make arrangements for you.

Discrimination and Harassment

If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). Please see Student Bill of Rights, section E [http:// regulations.utah.edu/academics/6-400.php](http://regulations.utah.edu/academics/6-400.php).

Names/Pronouns

Canvas allows students to change the name that is displayed AND allows them to add their pronouns to their Canvas name. Class rosters are provided to the instructor with the student's legal name, as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account, which can be managed at any time). Although CIS refers to this item as merely a preference, we will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise us of any name or pronoun changes so that we can help create a learning environment in which you, your name, and

your pronoun are respected. If you need any assistance or support, please reach out to the LGBT Resource Center at https://lgbt.utah.edu/campus/faculty_resources.php.

English Language Learners

If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include the Writing Center (<http://writingcenter.utah.edu/>), the Writing Program (<http://writing-program.utah.edu/>), and the English Language Institute (<http://continue.utah.edu/eli/>). Please let us know of any additional support you would like to discuss for this class.

Undocumented Student Support

Immigration is a complex phenomenon with broad impact, including those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA), as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu

Veterans Center

If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>. Please also let us know if you need any additional support in this class for any reason.

Wellness

Personal concerns, such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Student Success Advocates

The mission of Student Success Advocates is to support students in making the most of their University of Utah experience (ssa.utah.edu). They can assist with mentoring, resources, and more. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support (<https://asuu.utah.edu/displaced-students>).

The Americans with Disabilities Act

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access. *Given the nature of this course, attendance is required and adjustments cannot be granted to allow non-attendance. However, if you need to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA). CDA will work with us to determine what, if any, ADA accommodations are reasonable and appropriate.*

University Safety Statement

The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu

Addressing Sexual Misconduct

Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability,

veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

University Counseling Center

The University Counseling Center (UCC, <https://counselingcenter.utah.edu/>) provides developmental, preventive, and therapeutic services and programs that promote the intellectual, emotional, cultural, and social development of University of Utah students. They advocate a philosophy of acceptance, compassion, and support for those they serve, as well as for each other. They aspire to respect cultural, individual and role differences as they continually work toward creating a safe and affirming climate for individuals of all ages, cultures, ethnicities, genders, gender identities, languages, mental and physical abilities, national origins, races, religions, sexual orientations, sizes and socioeconomic statuses.

Office of the Dean of Students

The Office of the Dean of Students (<https://deanofstudents.utah.edu/>) is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. Please consider reaching out to the Office of Dean of Students for any questions, issues and concerns. 200 South Central Campus Dr., Suite 270. Monday-Friday 8 am-5 pm.

Copyrighted Content

All course material that is substantively generated by the instructors of this course is considered copyrighted by the same instructors. Delivery of this material in an electronic format to the course webpage, links contained therein, or via email does not forfeit this copyright. Posting of this material by students on external websites—including “study” websites—or otherwise disseminating this material without the author's written consent is a copyright violation and is illegal. Violations of these policies may lead to sanctions dictated by the Student Code of Conduct, as well as legal action by the authors and/or the University.

COVID-19 Statement

*University leadership has urged all faculty, students, and staff to **model the vaccination, testing, and masking behaviors** we want to see in our campus community.*

These include:

- *Vaccination*
- *Masking indoors*
- *If unvaccinated, getting weekly asymptomatic coronavirus testing*

Vaccination

- **Get a COVID-19 vaccination** if you have not already done so. Vaccination is proving highly effective in preventing severe COVID-19 symptoms, hospitalization and death from coronavirus. Vaccination is the single best way to stop this COVID resurgence in its tracks.
- Many in the campus community already have gotten vaccinated:
 - More than 80% of U. employees
 - Over 70% of U. students
- Visit <http://mychart.med.utah.edu/>, <http://alert.utah.edu/covid/vaccine>, or <http://vaccines.gov/> to schedule your vaccination.

Masking

- While masks are no longer required, **you can wear a mask if you choose to**
 - Check the CDC website periodically for masking updates—<https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated-guidance.html>
 - Treat masks like seasonal clothing (i.e. during community surges in COVID transmission, masks are strongly encouraged indoors and in close groups outside).

Testing

- **If you are not yet vaccinated, get asymptomatic coronavirus tests.** This is a helpful way to protect yourself and those around you because asymptomatic individuals can unknowingly spread the coronavirus to others.

- *Asymptomatic testing centers are open and convenient:*
 - *Online scheduling*
 - *Saliva test (no nasal swabs)*
 - *Free to all students returning to campus (required for students in University housing)*
 - *Results often within 24 hours*
 - *Visit alert.utah.edu/covid/testing*
- **Remember: Students must self-report if they test positive for COVID-19** via this website: <https://coronavirus.utah.edu/>.

Diverse Student Support

Your success at the University of Utah is important to all of us here! If you feel like you need extra support in academics, overcoming personal difficulties, or finding community, the U is here for you.

Student Support Services (TRIO)

TRIO federal programs are targeted to serve and assist low-income individuals, first-generation college students, and individuals with disabilities.

Student Support Services (SSS) is a TRIO program for current or incoming undergraduate university students who are seeking their first bachelor's degree and need academic assistance and other services to be successful at the University of Utah.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

Student Support Services (TRIO)

801-581-7188

trio.utah.edu

Room 2075

1901 E. S. Campus Dr.

Salt Lake City, UT 84112

American Indian Students

The AIRC works to increase American Indian student visibility and success on campus by advocating for and providing student centered programs and tools to enhance academic success, cultural events to promote personal well-being, and a supportive “home-away-from-home” space for students to grow and develop leadership skills.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

American Indian Resource Center

801-581-7019

diversity.utah.edu/centers/airc

Fort Douglas Building 622

1925 De Trobriand St.

Salt Lake City, UT 84113

Black Students

Using a pan-African lens, the Black Cultural Center seeks to counteract persistent campus-wide and global anti-blackness. The Black Cultural Center works to holistically enrich, educate, and advocate for students, faculty, and staff through Black centered programming, culturally affirming educational initiatives, and retention strategies.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

Black Cultural Center

801-213-1441

diversity.utah.edu/centers/bcc

Fort Douglas Building 603

95 Fort Douglas Blvd.

Salt Lake City, UT 84113

Students with Children

Our mission is to support and coordinate information, program development and services that enhance family resources as well as the availability, affordability and quality of child care for University students, faculty and staff.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

Center for Childcare & Family Resources

801-585-5897

childcare.utah.edu

408 Union Building

200 S. Central Campus Dr.

Salt Lake City, UT 84112

Students with Disabilities

The Center for Disability Services is dedicated to serving students with disabilities by providing the opportunity for success and equal access at the University of Utah. They also strive to create an inclusive, safe, and respectful environment.

For more information about what support they provide and links to other resources, view their website or contact:

Center for Disability Services

801-581-5020

disability.utah.edu

162 Union Building

200 S. Central Campus Dr.

Salt Lake City, UT 84112

Students of Ethnic Descent

The Center for Ethnic Student Affairs offers several programs dedicated to the success of students with varied cultural and ethnic backgrounds. Their mission is to create an inclusive, safe campus community that values the experiences of all students.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

Center for Ethnic Student Affairs

801-581-8151

diversity.utah.edu/centers/cesa/

235 Union Building

200 S. Central Campus Dr.

Salt Lake City, UT 84112

English as a Second/Additional Language (ESL) Students

If you are an English language learner, there are several resources on campus available to help you develop your English writing and language skills. Feel free to contact:

Writing Center

801-587-9122

writingcenter.utah.edu

2701 Marriott Library

295 S 1500 E

Salt Lake City, UT 84112

English Language Institute

801-581-4600

continue.utah.edu/eli

540 Arapeen Dr.

Salt Lake City, UT 84108

Undocumented Students

Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles that prevent you from engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center.

Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families.

For more information about what support they provide and links to other resources, view their website or contact:

Dream Center

801-213-3697

dream.utah.edu

1120 Annex (Wing B)

1901 E. S. Campus Dr.

Salt Lake City, UT 84112

LGBTQ+ Students

The LGBTQ+ Resource Center acts in accountability with the campus community by identifying the needs of people with a queer range of [a]gender and [a]sexual experiences and responding with university-wide services.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

LGBTQ+ Resource Center

801-587-7973

lgbt.utah.edu ([Links to an external site.](#))

409 Union Building

200 S. Central Campus Dr.

Salt Lake City, UT 84112

Women

The Women's Resource Center (WRC) at the University of Utah serves as the central resource for educational and support services for women. Honoring the complexities of women's identities, the WRC facilitates choices and changes through programs, counseling, and training grounded in a commitment to advance social justice and equality.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

Women's Resource Center

801-581-8030

womenscenter.utah.edu

411 Union Building

200 S. Central Campus Dr.

Salt Lake City, UT 84112

