

Chem 375: Solid State Chemistry

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| Instructor | Robin S. Tanke |
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| E-mail: | rtanke@uwsp.edu |
| Office: | CBB 447 |
| Office Hours: | Tuesday and Friday 10 AM – 11AM, Thursday 2PM – 3PM by appointment or drop in. |

Prerequisite: Chem 325 or Chem 220 Concurrent

Class Sessions:

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| Lecture: | M, W, F 9:00 – 9:50 | CBB 261 |
| Lab | W 2:00 -5:00 PM | CBB 420 |

Purpose: The purpose of this course is to introduce students to different materials including metals (alloys), ceramics (glasses), natural and synthetic polymers, semiconductors and composites and to discuss how the structure of a material relates to the chemical, mechanical, electrical, magnetic and optical properties.

Learning Outcomes: Upon completing this course, students will be able to:

- Describe crystalline materials in detail and the influence of defects on the properties of materials.
- Explain the different bonding types and which apply to the different types of materials (solids, metals, ceramic, polymers, etc.)
- Perform and describe various syntheses of solid state materials.
- Discuss and as possible use a variety of methods to characterize solid state materials such as X-ray diffraction, spectroscopy, microscopy and thermal analysis
- Describe properties of solids such as:
 - *mechanical* - tension, compression, and sheer strength, brittle vs malleable vs tough, elastic vs rigid;
 - *electrical* - conductor, semiconductor, insulator; piezoelectric, pyroelectric, and ferroelectric
 - *optical* – transparent, reflective, opaque; absorption, emission, refraction
 - *thermal* – conductor, insulator; melting and glass transition temperatures;
 - *chemical* - resistance to various types of reactions, heterogeneous catalysts;
 - *magnetic* - diamagnetic, paramagnetic, ferromagnetic, antiferrimagnetic

Required Texts and materials:

Available from text rental: West, A. Solid State Chemistry and its Applications, Second Edition, Student Edition. Wiley 2014 and its companion website.

To purchase:

- A bound laboratory notebook.
- Safety Goggles
- A clean flash drive for data storage; for some instruments this is the only way to save data.

Grading: There are 750 points for the class. You will be issued the following letter grades A above 695 points; B above 620 points; C above 540 points; D above 485, below 485 F. Minus and plus grades will be issued to students close to the cutoff grades.

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| 5 Homework Assignments | 5 x 25 points each | 125 points |
| 4 Exams | 4 x 70 points each | 280 points |
| Labs | detailed in the Lab schedule | 195 points |
| Final | Cumulative | 150 points |

Exam Schedule:

- 📅 Exam 1: Friday, September 30, 2022
- 📅 Exam 2: Friday, October 21, 2022
- 📅 Exam 3: Friday, November 11, 2022
- 📅 Exam 4: Friday, December 2, 2022

Final Exam: Wednesday, December 21, 2022, 2:45 – 4:45 PM CBB 261

POLICIES AND OTHER CONSIDERATIONS

UWSP Community Bill of Rights and Responsibilities

UWSP values a safe, honest, respectful, and inviting learning environment. In order to ensure that each student has the opportunity to succeed, a set of expectations have been developed for all students and instructors. This set of expectations is known as the Rights and Responsibilities document, and it is intended to help establish a positive living and learning environment at UWSP. For more information go to:

https://www.uwsp.edu/dos/Documents/2015_Aug_Community%20Rights%20and%20Responsibilities%20Web.pdf

The Rights and Responsibilities document also includes the policies regarding academic misconduct are found on page 11.

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) is a federal law requiring educational institutions to provide reasonable accommodations for students with disabilities.

If you have a disability and require classroom and/or exam accommodations, please register with the Disability and Assistive Technologies Center and then contact me at the beginning of the course. I am happy to help in any way I can. For more information, please visit the DATC, located on the 6th floor of the Learning Resource Center (the Library). You can also find more information here:

<https://www.uwsp.edu/datc/Pages/contact.aspx>

Attendance

If you are able, please attend class. If you are ill, class lectures will be recorded (as possible) and posted on CANVAS. Should I become ill, lectures will be held via ZOOM; please check your e-mail regularly. If

the need to miss lab arises, please contact me as soon as possible. We will work together on how to proceed depending on how long you will have to be out and your individual circumstances.

All handouts will be posted on CANVAS. Homework assignments and typed lab reports will be uploaded to CANVAS or handed in. All exams and your lab notebook (completed with data) will be handed in at designated dates.

Schedule for Robin Tanke Fall Semester 2022

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|-------|---------------------|--------------------------|---------------------|---------------------|-----------------------|
| 08:00 | | | | | |
| 09:00 | 375 Lec 01 261 | | 375 Lec 01 261 | | 375 Lec 01 261 |
| 10:00 | | Office Hour | | | Office Hour |
| 11:00 | | Research and Outreach | | 326 Lab 01L1 426 | |
| 12:00 | 326 Lec 01 105 | | 326 Lec 01 105 | 326 Lab 01L1 426 | 326 Lec 01 105 |
| 13:00 | | | | 326 Lab 01L1 426 | |
| 14:00 | 326 Lab 01L2 426 | | 375 Lab 01L1 420 | Office Hour | Department meeting |
| 15:00 | 326 Lab 01L2 426 | Curriculum Committee | 375 Lab 01L1 420 | | |
| 16:00 | 326 Lab 01L2 426 | | 375 Lab 01L1 420 | | |

Tentative Course Schedule

| Week | Topic | Evaluation |
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| 1 (9/7- first class day) | Chapter 1: Symmetry elements, Crystal systems, Bravais Lattices and Miller Indices. | X-ray Safety Training due by 9/7 at 1PM. |
| 2 (9/12) | Chapter 1: Unit cell densities and bond lengths, common crystal forms for metals and ionic compounds | All about me due by 9AM 9/12 |
| 3 (9/19) | Chapter 2: Crystal Defects, Non-stoichiometric and Solid Solutions | Homework 1 due 9AM Friday 9/23 |
| 4 (9/26) | Chapter 3: Bonding in Solids | Exam 1 Friday 9/30 Chapters 1-2 |
| 5 (10/3) | Chapter 4: Synthesis and processing of inorganic solids. | |
| 6 (10/10) | Chapter 4: Synthesis and processing of inorganic solids. | Homework 2 due Friday, 10/14 |
| 7 (10/17) | Chapter 5: X-ray Diffraction | Exam 2 Chapters 3-4 10/21 |
| 8 (10/24) | Chapter 6: Microscopy and Spectroscopy Techniques | |
| 9 (10/31) | Chapter 6: Thermal Techniques; Supplement: Organic Polymers | Homework 3 due Friday, 11/4 |
| 10 (11/7) | Organic Polymers and Chapter 7: Phase Diagrams | Exam 3 Chapters 5, 6 and Polymers 11/11 |
| 11 (11/14) | Chapter 8: Electrical properties | |
| 12 (11/21) | Chapter 8: Electrical properties, begin Chapter 9 (Thanksgiving – no class on Friday) | Homework 4 due Wednesday 11/23 |
| 13 (11/28) | Chapter 9: Magnetic Properties | Exam 4 Chapters 7-9 12/2 |
| 14 (12/5) | Chapter 10: Optical Properties and Nanomaterials | |
| 15 (12/12) | Nanotechnology and Review | Homework 5 due Wednesday 12/14 |
| 16 (12/16) | Wednesday, December 21, 2022 2:45 – 4:45 PM CBB 261 | Cumulative Final Exam |