

## **CHE 580: Inorganic Materials Chemistry (3 credit hours)**

**Class Times:** Tuesday and Thursday, 9:30 to 10:45 AM, CP-367  
**Instructor:** Dr. Beth S. Guiton  
**Office Address:** 148C Chemistry-Physics Building  
**Email:** [beth.guiton@uky.edu](mailto:beth.guiton@uky.edu)  
**Office Phone:** 257-4215  
**Office Hours:** Monday, 9:30 to 11:00 AM  
Tuesday, 2:00 to 3:30 PM  
*(email notification of intention to attend office hours is required at least one hour in advance)*

### **Course Description:**

Introduction to solid state inorganic materials chemistry, including atomic structure; optical, electronic, and magnetic properties; and characterization methods such as x-ray diffraction and electron microscopy.

### **Prerequisites:**

CHE 440G or CHE 547 or equivalent; and CHE 410G or 510 or equivalent; or permission from the instructor.

### **Student Learning Outcomes:**

After completing this course, the student will be able to:

1. Describe and identify basic crystal structures
2. Demonstrate comprehension of bonding in solids
3. Analyze experimental data to identify structural characteristics of solids
4. Describe and identify crystal defects, non-stoichiometry, and solid solutions, and predict the effects of these features on material properties
5. Interpret common phase diagrams to predict phase stability and phase transformations under different external conditions
6. Demonstrate comprehension of common electrical, magnetic, and optical characteristics of solids, and how these characteristics relate to structure and bonding
7. Critically evaluate published literature in the field of inorganic materials, interpret experimental data, and explain the pertinent details

### **Required Materials:**

1. *Solid State Chemistry and its Applications (Student Edition)*, Anthony R. West; 2<sup>nd</sup> Ed, Wiley (2014)

### **Optional Visualization Aids:**

1. Advanced Molecular Model Set for General and Organic Chemistry, LLC Mega Molecules (~\$20)
2. Polyhedral Model Kit, Institute for Chemical Education (~\$115)

3. CrystalMaker software suite: available in person in Dr. Parkin's x-ray diffraction facility, or remotely via VNC client

### **Course Assignments**

Distribution of the grade by assignment (graduate students)

- 3 Midterm exams at 10 percentage points each
- 1 Final exam at 30 percentage points
- 15 In-class quizzes (best of a maximum of 19) for a total of 20 percentage points
- 5 Literature entries to group Zotero library at 2 percentage points each
- 1 Group literature presentation at 10 percentage points

Distribution of the grade by assignment (undergraduate students)

- 3 Midterm exams at 10 percentage points each
- 1 Final exam at 30 percentage points
- 15 In-class quizzes (best of a maximum of 19) for a total of 20 percentage points
- 1 Group literature presentation at 20 percentage points
- Up to an additional 5 percentage points in extra credit will be assigned to any undergraduate student contributing to their group's Zotero library (see below).

### **Summary Description of Course Assignments**

#### ***Examinations:***

Four examinations will be given: three midterms and a Final. Unless announced otherwise Midterm 1 will examine the material covered in classes 1-6, Midterm 2 will examine the material covered in classes 7-10, Midterm 3 will examine the material covered in classes 11-18, and the Final will be cumulative.

#### ***Quizzes and Homework:***

Homework problems will be assigned every Tuesday and Thursday (by the end of the day), based on the material covered in class. One problem will be designated for the in-class quiz to be held in the first ten minutes of the following class. Solutions for homework problems will be made available, and these problems will form the basis of the midterm and final examinations.

#### ***Group Projects and Presentations:***

A central theme throughout this course will be a group project to explore and understand the Inorganic Materials Chemistry literature. Each group of around four students will contain a mixture of graduate and undergraduate students, whose responsibilities will be different (see below). The project will have two parts:

(i) Building a reference library. Throughout the semester, each group will work together to choose key papers from the literature which illustrate or use material explored in the class. Each group will be required to submit a minimum of five entries (at given deadlines) to an online library using the Zotero program, to fulfill the following criteria:

- the paper must be from a peer-reviewed journal with impact factor >1
- the paper must have been recently published, or be well-cited (as judged subjectively by the group)

- the paper must describe original research (no review articles)
- each paper may be entered into the library only one time (no duplicates)

Once your group has chosen a paper, upload it to the group Zotero library, including (i) a pdf copy of the paper, and (ii) a note containing the names of the group members who contributed to the choice, and a brief justification for the choice of paper. Guidance will be given for the first three paper submissions during three class sessions devoted to these literature searches. Groups must arrange to meet outside of class to make the subsequent two (or more) choices.

**Graduate Students** will be awarded two percentage points of their final grade for each paper uploaded which fulfills the above criteria, and also has the student's name listed in the attached note (up to a maximum of ten percentage points).

**Undergraduate Students** will be awarded one percentage point of extra credit to their final grade for each paper uploaded which fulfills the above criteria, and also has the student's name listed in the attached note (up to a maximum of five extra credit points).

(ii) Literature Presentations. Short presentations of the literature will be given by each group during the week before dead week. Papers from the class reference library will be assigned by the instructor to each group, not later than one week before the presentations. Papers assigned will be chosen from the compiled library, as appropriate to the theme of the presentation; the group's assigned papers will likely include both those contributed by their own group, as well as by their classmates in other groups (as dictated by subject matter). Further details will be given in class, and will be based around the following guidelines:

- The presentations should be 10 minutes long *plus* 5 minutes for questions
- The presentations should introduce a general topic with examples provided by the assigned literature, and explained using material learned in CHE 580
- You will receive a score out of 40, with 25 points assigned individually (for Content, Structure, Delivery, and Group Participation), and 15 points assigned to each group member (for Content, Structure, and Group Dynamic) (see attached rubric)
- Assessments of your group members and the slides from your presentation should be communicated to the instructor *via* email in the week following the presentation. Assign a score from 0 to 5 for each group member, and a brief justification for that score (one sentence is fine), regarding the contribution you felt that your group member gave, in terms of preparing and giving the presentation and contributing to the group dynamic. Additionally, provide a score for yourself, and how your contribution could have enhanced the performance of your other group members.

**Grading scale (Graduate Students):**

85 – 100% = A; 75 – 84% = B; 60 – 74% = C; Less than 60% = E

Ranges may be lowered but will not be raised.

**Grading scale (Undergraduate Students):**

85 – 100% = A; 75 – 84% = B; 60 – 74% = C; 50 – 59% = D; Less than 50% = E  
Ranges may be lowered but will not be raised.

**Final Exam Information**

Monday, May 2, 1:00 to 3:00 PM, Room 367 Chemistry-Physics Building

**Mid-term Grade**

Mid-term grades will be posted in myUK by the deadline established in the Academic Calendar (<http://www.uky.edu/Registrar/AcademicCalendar.htm>)

**Tentative Course Schedule****Assignment due dates, and examination dates:**

Literature search class:	Tuesday January 26 (1 <sup>st</sup> Zotero submission due)
Literature search class:	Thursday February 4 (2 <sup>nd</sup> Zotero submission due)
Midterm examination 1:	Tuesday February 16, 9:30 to 10:45 AM
Literature search class:	Thursday February 25 (3 <sup>rd</sup> Zotero submission due)
Midterm examination 2:	Tuesday March 8, 9:30 to 10:45 AM
4 <sup>th</sup> Zotero submission due:	Thursday March 10
Spring break:	March 14-19
5 <sup>th</sup> Zotero submission due:	Thursday March 31
Midterm examination 3:	Thursday April 14, 9:30 to 10:45 AM
Literature Presentations:	April 21
Dead Week:	April 25-30
Review class:	Tuesday April 26
Class canceled:	Thursday April 28
Final examination:	Monday May 2, 1:00 to 3:00 PM

**List of topics (tentative class schedule):**

1. Crystal Structures (classes 1-4)
2. Bonding in Solids (classes 5-8)
3. Crystallography and Diffraction Techniques (classes 9-10)
4. Other Techniques (class 11)
5. Crystal Defects, Non-Stoichiometry and Solid Solutions (classes 12-15)
6. Phase Diagram Interpretation (class 16)
7. Electrical Properties (classes 17-18)
8. Magnetic and Optical Properties (classes 19-20)

**Course Policies:****Excused Absences:**

Students need to notify the professor of absences prior to class when possible. *Senate Rules 5.2.4.2* defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit “reasonable cause for nonattendance” by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Two weeks prior to the absence is reasonable, but should not be given any later. Information regarding major religious holidays may be obtained through the Ombud (859-257-3737, [http://www.uky.edu/Ombud/ForStudents\\_ExcusedAbsences.php](http://www.uky.edu/Ombud/ForStudents_ExcusedAbsences.php)).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused) per University policy.

Per *Senate Rule 5.2.4.2*, students missing any graded work due to an excused absence are responsible: for informing the Instructor of Record about their excused absence within one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The professor must give the student an opportunity to make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible, during the semester in which the absence occurred.

***Verification of Absences:***

Students may be asked to verify their absences in order for them to be considered excused. *Senate Rule 5.2.4.2* states that faculty have the right to request “appropriate verification” when students claim an excused absence because of illness, or death in the family.

Appropriate notification of absences due to University-related trips is required prior to the absence when feasible and in no case more than one week after the absence.

***Academic Integrity:***

Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the University may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: <http://www.uky.edu/Ombud>. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

*Senate Rules 6.3.1* (see <http://www.uky.edu/Faculty/Senate/> for the current set of *Senate Rules*) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work, which a student submits as his/her own, whoever that other person may be. Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone.

When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

***Accommodations due to disability:***

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at [drc@uky.edu](mailto:drc@uky.edu). Their web address is <http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/>.

***Accommodations for victims of violence:***

By federal law, any student who is a victim of dating violence, domestic/intimate partner violence, sexual assault, or stalking (whether on or off campus) is entitled to appropriate accommodations for his or her coursework. To get help getting accommodations and other support, students who are assaulted can do any of the following:

1. Tell your instructor who can assist you in accessing resources appropriate to your situation;
2. Call the UK VIP Center (Violence Intervention and Prevention Center) at 257-3574 or [vipcenter@uky.edu](mailto:vipcenter@uky.edu) or [http://www.uky.edu/StudentAffairs/VIPCenter/about\\_contact.php](http://www.uky.edu/StudentAffairs/VIPCenter/about_contact.php); or walk in to the Center in Frazee Hall, lower level, between 8:30 and 5:00;
3. Call the University Counseling Center at 257-8701; 2nd floor, Frazee Hall;

4. Call Ms. Patty Bender from the UK Institutional Equity and Equal Opportunity at 257-8927 or [patty.bender@uky.edu](mailto:patty.bender@uky.edu); or
5. **In the case of an emergency, contact the UK Police Department at 911.**
6. Students may also contact community resources 24-hours a day, including:
  - a. Bluegrass Rape Crisis Center at 800.656.4673 or <http://bluegrassrapecrisis.org/>
  - b. Greenhouse17 (formerly Bluegrass Domestic Violence Program) at 800.544.2022 or <http://greenhouse17.org/>

***Grading Rubric for Literature Presentations:***

Group: 1 (Topic)		Person A	Person B	Person C	Person D	Group
<b>Content</b>	Analysis (understanding)	/5	/5	/5	/5	
	Reasoning (supporting evidence)	/5	/5	/5	/5	
	Material (comprehensive, pertinent)					/5
<b>Structure</b>	Macro (thesis statement, transitions)	/5	/5	/5	/5	
	Macro (logical flow, transitions)					/5
<b>Delivery</b>	Use of voice, body, presentational aids	/5	/5	/5	/5	
<b>Group</b>	Contribution (score 1)					
	Contribution (score 2)					
	Contribution (score 3)					
	Contribution (score 4)					
	Group dynamic (average)	/5	/5	/5	/5	
	Group dynamic (instructor)					/5
<b>Score</b>	Individual /25					
	Group /15					
	Total /40					