Advanced Materials Chemistry
The University of Toledo
Department of Chemistry & Biochemistry
Chem 6800-001/8800-001, CRN# 21131, 21132
Spring 2018

Instructor: Cora Lind-Kovacs
Term: Spring 2018
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Class location: FH 2210
Office Hours: MTWR 1-2 or by appointment
Class Day/Time: MW 10:00-11:50
Office: Wolfe Hall 2262
Credit Hours: 4
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COURSE/CATALOG DESCRIPTION
Introduction to important classes of solids, including conductors, magnetic materials, ferroelectrics, glasses, microporous materials, organic solids. Traditional and novel synthetic approaches, structure/property relationships, and characterization methods specific to solids.

STUDENT LEARNING OUTCOMES
Students will learn about major classes of solids based on specific sets of properties and how these properties arise from the structure of these materials. They will become knowledgeable about traditional synthetic routes that allow preparation of thermodynamically stable materials as well as novel synthetic approaches that can be used to gain kinetic control or prepare particles with specific shapes or sizes. This will enable them to choose suitable methods to prepare desired materials in their own research. Appropriate characterization methods for different classes of solids will also be introduced so that students will be familiar with the tools necessary to characterize solids.

The course is concerned with the basic principles of solid-state chemistry. It is designed to give an overview of important classes of solids (both inorganic and organic), different synthetic approaches to thermodynamically stable and metastable compounds, characterization methods, and structure/property relationships. While we will address some physical and engineering topics, the main focus of the class will be the CHEMISTRY of solids. This includes questions like how different synthetic methods can change what products you can obtain, or how changes in atomic composition or molecular structure affect properties. Course topics will include nomenclature specific to the solid-state chemistry community to describe subsets of solid-state materials based on commonalities in structure and/or properties, major instruments/tools used for identification/characterization of materials and their properties, as well as in-depth discussion of certain physical/chemical topics relevant for understanding solid-state materials like band structure etc. At the end of the course, students will have the background knowledge necessary to interact with solid-state chemists working on a variety of materials and to design their own synthetic pathways to advanced materials.

PREREQUISITES AND COREQUISITES
Prerequisite: Permission of department. This course has no formal prerequisites, however, some math background and intimate knowledge of General Chemistry topics is expected.

REQUIRED TEXTS AND ANCILLARY MATERIALS
Class handouts will be provided on Blackboard. These should be considered as an outline of the lectures and should be augmented with your own notes during class. It is not necessary to buy a text book for this class, but there are many general as well as specialized solid-state texts that can be used for further reading.
TECHNOLOGY REQUIREMENTS
In-class presentations on selected topics will be part of student grades. A computer is available in the classroom, or a personal laptop can be used. Access to standard office software (excel, powerpoint) will be necessary to finish all class assignments.

UNIVERSITY POLICIES
Policy Statement on Non-Discrimination on the basis of Disability (ADA): The University is an equal opportunity educational institution. Please read The University’s Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance (https://www.utoledo.edu/policies/administration/diversity/pdfs/3364_50_03_Nondiscrimination_o.pdf).

Academic Accommodations
The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office (https://www.utoledo.edu/offices/student-disability-services/).

COURSE EXPECTATIONS
Class attendance is strongly recommended. You will be responsible for the material covered in all classes (and homework assignments), whether you attend them or not. Asking questions during class is strongly encouraged. Please do not be afraid to speak up if you are unclear about something! There are probably several other students who are having trouble with the same point, and it will allow me to clarify the topic for you.
You can drop this class with no record on your transcript until 1/30. Withdrawal between 1/30 and 3/30 will result in a ‘W’ grade. You cannot withdraw from the course after 3/30.
Academic dishonesty as outlined in the University of Toledo policies will not be tolerated and may result in an ‘F’ grade for the class.

GRADING
Grades are calculated based on your performance on homework, in-class presentation, midterm exams and final exam. Work submitted late is subject to point deduction unless an exception was approved prior to deadline.

Midterm Grading
Midterm grades will be entered before the withdrawal deadline, and will be calculated based on performance on assignments and exams completed prior to that date, normalized to 100%.

Final Grading
Final grades are based on a simple 5% interval scale, and you need to earn the following minimum overall percentages to achieve the corresponding grades: 90% A, 85% A-, 80% B+, 75% B, 70% B-, 65% C+, 60% C, 55% C-, 50% D+, 45% D, 40% D-. Please note that grades will NOT be curved, so you can calculate where you stand at any time!

The course grade will be based on the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework (4 sets, 5% each)</td>
<td>20%</td>
</tr>
<tr>
<td>Oral presentation in class</td>
<td>15%</td>
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<tr>
<td>2 in-class exams (20% each)</td>
<td>40%</td>
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<tr>
<td>Final exam</td>
<td>25%</td>
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If you score 85% or higher on the comprehensive final exam, your worst grade (combined homework grade, oral presentation grade, individual in-class exam grade) will be dropped for the final grade calculation.
Assignments/Assessment Description

Four homework assignments (5% of overall grade each) will be given in class at least one week before the work is due. Assignments are due at the beginning of class. If there are special circumstances that necessitate that you hand your homework in late (e.g., several exams that week, medical issues in the family, conference travel etc.), please inform me ASAP so that we can negotiate a different due date. You may work on homework in groups, however, it is recommended that you make sure you understand the problem solving process and do not simply copy someone else’s results!

Note that homework will be due at the beginning of class on the due date. Late homeworks will be subject to a nominal point deduction.

Presentation. (15% of grade) Each student will choose a presentation topic during the first three weeks of classes. The topics will be different classes of solid-state materials. You can either propose a topic yourself, or pick one from a list of topics that I have compiled. You will be required to give a 45 minute presentation in class towards the end of the semester.

Exams. The two in-class exams (20% of overall grade each) will be given during class periods on Monday, 2/19 and Wednesday, 3/28. The final exam (25% of grade) will take place on Monday, 4/30 (10:15 am-12:15 pm).

Make-up exams will only be given for excused absences (refer to the “University of Toledo Missed Class Policy” for excused absence situations).

No classes will be held on 1/15 (MLK Holiday), 3/5 and 3/7 (Spring Break).

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
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| 1    | January 15-19 | MLK HOLIDAY  
Introduction to solids  
Structure/Crystallography basics |
| 2    | January 22-26 | Bonding |
| 3    | January 29-February 2 | Phase diagrams  
Synthetic methods |
| 4    | February 5-9 | Synthetic methods (high + low T) |
| 5    | February 12-16 | Low temperature synthetic methods |
| 6    | February 19-23 | EXAM I on 2/19  
Characterization of solids |
| 7    | February 26-March 2 | Defects & ionic conduction |
| 8    | March 5-9 | SPRING BREAK |
| 9    | March 12-16 | Electronic properties |
| 10   | March 19-23 | Magnetic properties |
| 11   | March 26-30 | Magnetic properties (cont)  
EXAM II on 3/28 |
| 12   | April 2-6 | Superconductors  
Piezo+Ferroelectrics |
| 13   | April 9-13 | Microporous materials  
Glasses |
| 14   | April 16-20 | Organic solids |
| 15   | April 23-27 | In-class presentations  
Review |
| 16   | April 30-May 4 | FINAL EXAM on 4/30 10:15-12:15 |