Mechanical and Aerospace Engineering 251  
Structure and Analysis of Solids 

Department of Mechanical and Aerospace Engineering  
Jacobs School of Engineering  
University of California, San Diego 

Fall 2017 Syllabus 

COURSE DESCRIPTION 

Key concepts in the atomic structure and bonding of solids. Symmetry operations, point groups, lattice types, space groups, inorganic compounds, structure/property comparisons, X-ray diffraction. Ionic, covalent, metallic bonding compared with physical properties. Atomic and molecular orbitals, bands vs. bonds, free electron theory. 

Prerequisites: Consent of instructor. 

GENERAL COURSE INFORMATION 

Instructor: Dr. Olivia A. Graeve  
Phone: (858) 246-0146  
E-mail: ograeve@ucsd.edu  
Course web site: http://graeve.ucsd.edu/MAE251/ 
Office Hours: Wednesdays, 9:00 – 10:00 AM or by appointment  
(no office hours on October 4, October 11, November 8, December 6; feel free to email me for a special appointment if you need to see me that week)  
Office: Jacobs Hall 3115 
Course meetings: MW, 7:30 – 8:50 AM  
Classroom: PCYNH 122 

REQUIRED TEXT 


TOPICS 

- Bravais lattices  
- Unit cell planes and directions  
- Unit cell distances, angles, and volumes  
- Closed-packed structures  
- Prototype structures  
- Secondary bonding  
- Ionic bonding  
- Metallic bonding  
- Covalent bonding  
- Compound and structure formation 

COURSE OBJECTIVES 

All students who participate in MAE 251 should come away with: 

- Knowledge of how bonding and crystal structure are interdependent.  
- A recognition of the different close-packed and prototype crystal structures.  
- An identification of ways that bonding and structure define compound and structure formation.
A recognition of secondary, ionic, metallic, and covalent bonding.

LEARNING OUTCOMES

Students who follow course requirements and practices can expect, at the end of the semester, to be able to:

- Apply the basic principles of chemistry for the formation of crystal structures.
- Describe secondary, ionic, metallic, and covalent bonding.
- Describe the essential properties of the elements that result in specific crystal structures.
- Apply phase stability principles for the formation of compounds and crystal structures.

EXAMINATIONS

There will be one mid-semester examination and one final examination. The dates of each examination are indicated in the Lecture Schedule. Absence during examinations, without prior approval, will result in a zero. Prior approval will be given only under exceptional circumstances.

ASSIGNMENTS

Homework will be assigned in class and must be submitted on the date specified by the instructor. Clarification on the due date for each assignment will be given in class. No late homework will be accepted.

GRADING

Students will be graded using the following breakdown:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Midterm examination</td>
<td>30%</td>
</tr>
<tr>
<td>Final examination</td>
<td>40%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>30%</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
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MAE 251 STUDENT HONOR CODE

I have read the honor code below and agree with its provisions. My continued enrollment in this course constitutes full acceptance of this code:

I will not:

- give information or receive information from another person during an exam,
- use more reference material during an exam than is allowed by the instructor,
- plagiarize information from books, journals, or the Internet,
- alter an exam after it has been graded and return it to the instructor for regrading, and
- copy another person's homework solutions and submit them as my own.

HOMEWORK AND EXAMINATION SOLUTIONS

Solutions to all homework and examination solutions will be posted electronically on the following web site: http://graeve.ucsd.edu/MAE251/HomeworkSolutions.html

E-MAIL ETIQUETTE

Email is a very public means of information exchange, which should be treated with respect. As such, I expect that all students will write and respond to emails in a respectful manner.
An example of an appropriate email is:

October 1, 2017

Dear Dr. Graeve:

Could you please inform me of the reading assignment for this week?

Thank you,

John Doe

An example of an inappropriate email is:

Hey you what is the homework this week

This last email has misspellings, inappropriate punctuation, no salutation, no signature, no date, and is extremely disrespectful.

Note: Do not write emails that you would not want your mother or your lawyer to read. Assume, at all times, that everyone in the world will read any email you write.

DISABILITIES ACCOMMODATION

All students with disabilities who wish to request accommodations should contact the Office for Students with Disabilities. All information disclosed to this office by students will remain confidential, but the office will provide documentation that supports accommodations within the classroom (e.g., examination accommodations, notes, etc.). Please keep in mind that many accommodations require early planning, so requests should be made as soon as possible.

IDEA STUDENT CENTER

The IDEA Student Center, located just to the right of the lobby of Jacobs Hall, is a hub for student engagement, academic enrichment, personal/professional development, leadership, community involvement, and a respectful learning environment for all. The Center offers a variety of programs, listed in the IDEA Center Facebook page at http://www.facebook.com/ucsdidea/ (you are welcome to Like this page!) and the Center web site at http://idea.ucsd.edu/.
## LECTURE SCHEDULE

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Assigned Reading</th>
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<tbody>
<tr>
<td>Mon, October 2</td>
<td>Bonding and crystal systems</td>
<td>pp. 23-74</td>
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<tr>
<td>Wed, October 4</td>
<td>Crystallographic computations</td>
<td>pp. 75-103</td>
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<tr>
<td><strong>Sat, October 7</strong></td>
<td><em>10:00 - 11:20 AM</em></td>
<td>Crystallographic computations</td>
</tr>
<tr>
<td>Mon, October 16</td>
<td>X-ray diffraction</td>
<td>pp. 259-319</td>
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<tr>
<td>Wed, October 18</td>
<td>Metallic structures</td>
<td>pp. 425-465</td>
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<tr>
<td><strong>Sat, October 21</strong></td>
<td><em>2:00 - 3:20 PM</em></td>
<td>Space groups</td>
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<tr>
<td>Mon, October 23</td>
<td>Space groups</td>
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<tr>
<td>Wed, October 25</td>
<td>Metallic bonding</td>
<td>pp. 466-496</td>
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<tr>
<td>Mon, October 30</td>
<td>Quasicrystals</td>
<td>pp. 497-530</td>
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<tr>
<td>Wed, November 1</td>
<td>Midterm Examination</td>
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<tr>
<td>Mon, November 6</td>
<td>Electron diffraction I</td>
<td>pp. 125-131</td>
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<td>Wed, November 8</td>
<td>Amorphous metals</td>
<td>pp. 531-549</td>
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<td>Mon, November 13</td>
<td>Electron diffraction II</td>
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<tr>
<td>Wed, November 15</td>
<td>Ceramic structures</td>
<td>pp. 561-591</td>
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<td><strong>Sat, November 18</strong></td>
<td><em>10:00 - 11:20 AM</em></td>
<td>Point defects in ceramics</td>
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<td>Mon, November 20</td>
<td>Ionic bonding</td>
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<td>Wed, November 22</td>
<td>Atomic and molecular orbitals</td>
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<td>Mon, November 27</td>
<td>Covalent bonding</td>
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<tr>
<td>Wed, November 29</td>
<td>High-temperature superconductors and minerals</td>
<td>pp. 597-652</td>
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<tr>
<td>Mon, December 4</td>
<td>Molecular solids; secondary bonding</td>
<td>pp. 653-687</td>
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<tr>
<td>Mon, December 11</td>
<td><strong>Final Examination, 8:00 – 11:00 AM</strong></td>
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