COURSE: Materials Science and Engineering 201
TITLE: Phases and Phase Relations
LEVEL: Undergraduate
CREDIT: 3 hours lecture; 3 semester hours.
TIME: TR, 9:30-10:50 AM, CDT.
LOCATION: 2055 Sidney Lu Mechanical Engineering Building. Announcements, discussions, and lecture material will be available on Canvas (https://canvas.illinois.edu/courses/30079). Most assignments (except computational) & i>clicker questions will be posted and submitted through PrairieLearn (https://prairielearn.engr.illinois.edu).

DESCRIPTION: This course covers intermediate-level topics in materials science and engineering that bridge the introductory content of MSE 182 and the greater depth of the junior year curriculum. The topics to be covered are in general: bonding, crystal structures, phase equilibria and microstructure, quantitative examination of phases (crystalline and non-crystalline structures), and the relationships between phases (phase diagrams and phase transitions).

INSTRUCTOR: Prof. Nicola Perry (she/her)
Office: 102 MRL
Email: nhperry@illinois.edu

OFFICE HOURS: TBD!

DISCUSSION FORUM: Questions related to MSE201 homeworks, exams, and all course contents should be posted in Canvas discussion platforms. Please note that the TA primarily moderates/answers any questions posted there, and answers may take up to 1 business day. Particularly, the TA is not obligated to monitor the discussions outside of normal working hours.

TEACHING ASST: Mitisha Surana, email: msurana2@illinois.edu

PREREQUISITES: MSE 182; credit or concurrent enrollment in CHEM 104, MATH 231 and PHYS 211. (The prerequisite of MSE 182 is often waived for students who were not enrolled in the MatSE degree program in the fall semester of their freshmen year)

ASSESSMENT: Problem sets (8 estimate + 2 computational) 20%
i>clicker questions (graded on PrairieLearn) 10%
2 mid-semester exams, 50 min. each 40%
Final, comprehensive exam, 3 hrs. 30%

Sholl, D.S.; Steckel, J. A. “Density Functional Theory: A Practical Introduction”. All the textbooks are free to download as eBooks for U. Illinois students. Note that a list of known typos from the Hosford textbook will be posted on the Canvas course site, and students should consult this reference as they read through the book.

ASSESSMENT

1. ATTENDANCE

Class attendance is not required but is strongly recommended and may be mandatory on certain occasions (e.g., the Ethics lectures).

2. HOMEWORKS

Homeworks (HW) will be offered on PrairieLearn (https://prairielearn.engr.illinois.edu/). Please log in with your Illinois netID and enroll at MSE201 Fall 2022 semester. You will have infinite attempts to provide the right answer. If you complete the HW late you get 30% up to a week late. Past that, you get no credit but you can still practice the HW. Homworks must be completed by the due date at 5 PM, CDT. Leaving HW to the last-minute results in overloading of the system and errors leading to late delivery of the HW. Do your homework early! Homework solutions: homework questions will be solved in office hours after the HWs are due. No solutions will be posted otherwise.

Two computational assignments will be posted on Canvas (not on PrairieLearn). You will submit these assignments in the format of pdf on Canvas. There will be a computational TA and office hours (TBD) to assist you with those assignments. Grading of the computational assignments is however done by the “regular” course TA.

3. EXAMS

All exams will be performed at the CBTF facility (see below on p. 4 for more details). For the midterm exams, there will be a period of approximately 4 days over which you can take each exam, and you will book these times in advance. For the final exam, the timing is set by the registrar. CBTF will take care of adjusting exam features (e.g., duration) to accommodate official DRES requests (see p. 4).

TENTATIVE MIDTERM SCHEDULE
Midterm Exam No. 1 Mid-October, 50 min
Midterm Exam No. 2 Mid-November, 50 min

FINAL EXAM TBD during finals week ~ set by registrar

4. i>CLICKERS

i>clicker sessions will occur during class. Students should get the i>clicker Reef App. It is offered as a bundle if you get the physical i>clicker remote. We will not use the remotes. Students are strongly encouraged to participate, but no points will be registered. i>clicker questions will then be posted on PrairieLearn, and students can answer to obtain points. i>clicker questions will be made available after each class. Answers are due on the last day of class (December 6), but I strongly recommend that you do them gradually as they are posted after each class.

TENTATIVE TOPIC SCHEDULE

Introduction Callister 1
<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal Structures and Symmetries</td>
<td>Hosford 3, 4 (Waseda 2)</td>
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<tr>
<td>Scattering and Diffraction</td>
<td>Waseda 3 (Callister 3)</td>
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<tr>
<td>Defects in Crystalline Solids</td>
<td>Hosford 5</td>
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<tr>
<td>Bonding</td>
<td>Hosford 13</td>
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<tr>
<td>Basics of Calculations and Data Analysis</td>
<td>Hosford 21</td>
</tr>
<tr>
<td>Density Functional Theory – <em>primer</em> (+ Data Analysis)</td>
<td>Sholl 1, 2 (+ Hosford 21)</td>
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<tr>
<td>Phase Diagrams</td>
<td>Hosford 6, 7</td>
</tr>
<tr>
<td>Phase Diagrams Calculation (Thermocalc) – <em>primer</em></td>
<td>Hosford 7</td>
</tr>
<tr>
<td>Diffusion</td>
<td>Hosford 9</td>
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<tr>
<td>Phase Transformations</td>
<td>Hosford 10, 11</td>
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<td>Amorphous materials and the glass transition</td>
<td>Hosford 15</td>
</tr>
<tr>
<td>Polymer Structures</td>
<td>Callister 4</td>
</tr>
<tr>
<td>Ethics in Science and Engineering</td>
<td>Guest Lecture, <strong>mandatory</strong></td>
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**COURSE OBJECTIVES**

- Understand the relationship between bonding and crystal structures
- Describe and interpret the crystal structures of common metals, ceramics, polymers, and semiconductors
- Contrast the structure and properties of crystalline and non-crystalline materials
- Use concepts of point defect diffusion and nucleation to predict the kinetics of phase transformations
- Define a thermodynamic phase
- Interpret a phase diagram and categorize transformations between phases
- Become familiar with computational tools to calculate phase diagrams and the cohesive energy of a crystal
COVID-19
In-person attendance is encouraged but is not monitored/required, with the exception of the Ethics Lecture, which is mandatory. If you are feeling unwell, test positive for COVID, have a reasonable likelihood of having COVID, or are required to quarantine, please do not come to class. See the “letter of absence” information below if you must miss the Ethics Lecture. Lecture materials will be provided on the Canvas site, and all regular (non-computational) assignments can be completed remotely via PrairieLearn. As of the start of the semester, mask wearing is not required in classrooms; however, given the small size and high-density seating in MEB 2055 specifically, please consider wearing an effective mask.

General information for students is available here: https://covid19.illinois.edu/on-campus/on-campus-students/. If you feel ill or are unable to come to class or complete class assignments due to issues related to COVID-19, including but not limited to testing positive yourself, feeling ill, caring for a family member with COVID-19, or having unexpected child-care obligations, you should contact your instructor immediately, and you are encouraged to copy your academic advisor. A letter of absence may be required in such cases; see the Student Code (https://studentcode.illinois.edu/article1/part5/1-501/) for more details.

CBTF
This course uses the College of Engineering Computer-Based Testing Facility (CBTF) for its exams. The policies of the CBTF are the policies of this course, and academic integrity infractions related to the CBTF are infractions in this course. If you have accommodations identified by the Division of Rehabilitation-Education Services (DRES) for exams, please submit your LOA using the form linked at this site: https://cbtf.illinois.edu/students/dres at least 6 business days in advance of the first exam. If you have any issue during an exam, please inform the proctor immediately. Work with the proctor to resolve the issue at the time before logging off.

Diversity, Equity, and Inclusion Statement
The University of Illinois, the Grainger College of Engineering, the Materials Science and Engineering department, and MSE 201 operate under the guiding principle that “Our entire community benefits when individuals from different personal, cultural, and disciplinary perspectives are working together.” (https://grainger.illinois.edu/about/diversity). MSE 201 will be a safe and inclusive place for active learning with no tolerance for discrimination of any kind.

Academic Integrity Policy
The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. According to the Student Code, “It is the responsibility of each student to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions.” Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: http://studentcode.illinois.edu/. Ignorance is not an excuse for academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.
See also this quick reference guide to academic integrity: https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/

Academic Accommodations
To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon
as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@uiuc.edu. http://www.disability.illinois.edu. DRES accommodations will be implemented in the CBTF.

To obtain religious observance-related academic adjustments, students must inform the instructor within the first 3 weeks of the course. Since assignments and exams in MSE 201 each have a window of availability over several days, it is expected that most timing conflicts can be avoided.

Family Educational Rights and Privacy Act
Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa for more information.

Sexual Misconduct Policy and Reporting
The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University’s Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found at https://wecare.illinois.edu/resources/students/#confidential
Other information about resources and reporting is available at: https://wecare.illinois.edu

Community of Care
As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or http://odos.illinois.edu/community-ofcare/referral/). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at the Counseling Center (https://counselingcenter.illinois.edu/) or McKinley Health Center (https://mckinley.illinois.edu/). For mental health emergencies, you can call 911 or walk in to the Counseling Center, no appointment needed.