

**Syllabus**  
**MSE 404 AD: Alloy Design and Performance**  
**Spring 2026**

**Instructor:** Dr. Jessica TerBush, 207 Ceramics, 217-300-9924, [jterbush@illinois.edu](mailto:jterbush@illinois.edu)

**Office Hours:** Friday 1-2pm in 207 Ceramics (alternate location: 213 Ceramics)

**Laboratory:** 8:00-10:50am on Tues/Thurs in 111 and 112 Ceramics

**Course Description:** Design of metallic materials is generally targeted for a specific performance requirement. In this class, you will learn how to link the alloy's chemistry and composition to particular performance criteria.

**Course Objectives: In this course, students will...**

1. Demonstrate specific principles of alloy design through laboratory investigation.
2. Practice proper experimentation, use of instruments, and respect for safety.
3. Develop the written, graphical and oral communication skills that are essential to a clear presentation of your findings and a persuasive presentation of your thoughts.
4. Organize large bodies of data and information into logical, concise and accurate reports.

Students will specifically learn the following technical skills:

1. Preparation of specimens for microstructural observation (standard metallographic techniques)
2. Selection of appropriate techniques for microstructural characterization: x-ray diffraction, optical microscopy, scanning electron microscopy, energy dispersive spectroscopy, etc.
3. Performance of two standard mechanical property evaluations, hardness and tensile testing.
4. Qualitative and quantitative analysis of data collected (image processing, grain size measurements, phase fraction quantification, uncertainty quantification, etc)
5. Relation of the experimental data to theory as detailed in the description above.
6. Preparation of comprehensive yet concise lab reports of their findings.

**Text:** Handouts for individual experiments (on Canvas website)

**Relevant websites:**

Canvas: <https://canvas.illinois.edu/courses/63810>

CampusWire: <https://campuswire.com/c/GA2A29BC6/feed>

Box folder for shared data: <https://uofi.box.com/s/kvodw9lycahjkgeek8ivt71akffhws94>

**Course Outline:**

We will perform three different experiments over the course of the next eight weeks. Each experiment is scheduled to last four class sessions (therefore two weeks each). Students will work in pairs to complete the following experiments:

**1. Casting of Binary Al-Si Alloys**

*Hypoeutectic and hypereutectic binary Al-Si alloys will be cast by modifying a commercial Al alloy to compare to predictions to the phase diagram. Mechanical properties will also be tested to see how they vary with composition and microstructure.*

**2. Aqueous and Intergranular Corrosion**

*Aqueous corrosion of different alloys in saltwater solutions will be examined and weight loss over time will be measured. The results will be compared against electrodynamic polarization measurements. To examine intergranular corrosion, stainless steel will be heat treated, then the surface will be electrochemically etched to look for sensitization.*

**3. Oxidation of Titanium**

*Investigate the effect of time and temperature on the oxide formation for Ti and a Ti alloy*

**Group Rotations**

Rotation/Experiment	Al-Si Casting	Corrosion	Ti Oxidation
1	Groups A and D	Groups C and F	Groups B and E
2	Groups B and F	Groups A and E	Groups C and D
3	Groups C and E	Groups B and D	Groups A and F

## Schedule: Spring 2026

Week	Monday	Tuesday	Wednesday	Thursday
1		3/24 Lecture		3/26 Session 1
2		3/31 Session 2		4/2 Session 3
3		4/7 Session 4		4/9 Session 1
4		4/14 Session 2		4/16 Session 3
5		4/21 Session 4		4/23 Session 1
6		4/28 Session 2		4/30 Session 3
7		5/5 Session 4		5/7 Report Writing

## Teaching Assistants:

Joey Lin ([joeylin2@illinois.edu](mailto:joeylin2@illinois.edu)) and Vaibhav Vasudevan ([vv22@illinois.edu](mailto:vv22@illinois.edu))

## Lab Managers:

Nicole Robards	<a href="mailto:nrobards@illinois.edu">nrobards@illinois.edu</a>	212 Ceramics (4-7498)
Melissa Anderson	<a href="mailto:mka@illinois.edu">mka@illinois.edu</a>	212 Ceramics

## Grading and Policies

1. The overall grade will be split equally between the three experiments. This grade will be based on **pre-lab quizzes (20%), participation and involvement (20%), and lab reports (60%)**.
2. Pre-lab quizzes are to be submitted **individually** to Canvas before the first session of each experiment begins (i.e., 8am on relevant Tuesdays).
3. Participation will be evaluated **individually** by the course staff and will reflect your involvement and participation in the experiments. In other words, do not let your lab partner do all the work! These grades will be discussed and homogenized based on the input from all the course staff (instructor and TAs).
4. Lab reports are to be written in **groups of two** (pairs) with a single file submitted. Reports are due **the week after the experiment ends, by 5pm on Friday**.
5. Lab reports will be shorter and more concise than those in the junior labs (MSE 307/308). Specific details will be provided on Canvas, but 3-4 pages of text are expected.
6. Late assignments will be accepted up to three (3) days after the due date with a flat 20% reduction in score applied. Pre-lab quizzes submitted after this will not be accepted. Lab reports turned in more than 3 days late will still be graded but will incur a 50% reduction in score.
7. Accommodations will be made for serious/extended illness or other extenuating circumstances.

Please reach out to the instructor to request an accommodation.

8. You are expected to attend lab. If you need to miss lab for travel, illness, religious reasons, etc, please reach out in advance to discuss how the lab can be made up.
9. Final letter grades will be awarded depending on class average and the relative performance of the individual. An overall score of less than 50% is generally considered failing. The instructor reserves the right to adjust borderline grades based on student conduct.
10. Generative AI cannot be used to write your lab report for you, although using AI for background research or grammar checks is acceptable. All use of AI must be properly documented and cited, however.

### **Penalties:**

- **Copying or Sharing: 25 - 50%** penalty for **copying** or **sharing** from other reports (current or previous semesters). Data can be shared between groups (and should be for several of the experiments), but it needs to be properly cited and individually analyzed.
- **Plagiarism:** Plagiarism is taken seriously. Please make sure you submit your own work for every report.
- Plagiarism, copying, and misuse of AI must be reported through the University-wide FAIR system. As per the University Code of Policies and Regulations, the **instructor may impose one or more** of the following penalties **depending on the severity** of the infraction:
  - A reduced grade for the lab report
  - A "0" for the lab report
  - A reduced grade for the course
  - A failing grade for the course
  - Recommendation to the head of the department that the student be suspended or dismissed from the University

### **Laboratory Rules and Regulations:**

#### ***A) Safety:***

- 1) Always use appropriate **safety equipment** and **follow proper safety procedures**
- 2) Always bring your **own Safety Glasses** and wear them during the lab period
- 3) Always **wear proper attire** (long pants, closed-toe shoes, and lab coats)
- 4) **Long hair?** Properly contain it so that it will not be hazardous to you and to your fellow classmates and will not damage the very sensitive equipment in the labs
- 5) Inside the labs, **ABSOLUTELY NO:**
  - **Food** (solid or liquid) **or drinks**
  - **Roller Skates/Blades, skateboards, scooters, etc**

Anyone caught **violating** the above **laboratory rules**:

- Will be **removed** from the lab
- **No** compensating lab time will be given to complete the experiment(s)

6) **Online Lab Safety Training:** Everyone is required to complete three separate online training modules from the Division of Research Safety: **general lab safety** (likely completed for 307/308), **chemical safety** (parts 1 and 2), and **x-ray safety**. **Completion certificates must be uploaded to Canvas prior to the start of the first lab (Jan 27).** If you have already completed one or more of these modules, you do not need to repeat them (as long as they are still valid); you can download the completion certificate from your training history.

#### **B) General:**

- Please arrive **on time** for all labs. Arriving more than 30 minutes late will be counted as missing a lab in terms of participation.
- You are responsible for the **clean-up** of the common as well as the individual work areas at the end of your lab period
- After you are done with your experiment, you should not leave the lab premises **without checking with your TA**. Likewise, please check in with the TA if you need to leave the lab while experiments are running.
- Pay particular attention to the proper use of equipment and experimental procedures. Most experiments involve high temperatures, chemical usage, and/or mechanical hazards. We want everyone to be safe!
- Make sure all data is saved somewhere accessible prior to leaving the lab.

#### **University Policies to Note:**

**Emergency Situations:** Emergency response recommendations and campus building floor plans can be found at the following website: <https://police.illinois.edu/em/run-hide-fight/>. I encourage you to review this website within the first 10 days of class.

**Absence Policy:** Your attendance is required at each lab section, and lecture attendance is strongly encouraged for success in this class. If you need to miss lab for a planned absence (religious observance, conference, travel, interview, etc), please contact Dr. TerBush in advance to reschedule your lab.

For last minute absences (illness, family emergency, etc), please contact Dr. TerBush as soon as possible to discuss options for make-up. Likewise, if you need an extension on a report due to illness, travel, etc, please contact Dr. TerBush *in writing* prior to the due date to make arrangements.

**Mental Health:** Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

**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-of-care/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, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

**Student with Disabilities:** To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or visit the DRES website at <http://www.disability.illinois.edu/>. Here is the direct link to apply for services at DRES, <https://www.disability.illinois.edu/applying-services>.

**Disruptive Behavior:** Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu>; [conflictresolution@illinois.edu](mailto:conflictresolution@illinois.edu); 333-3680) for disciplinary action.

**Sexual Misconduct Reporting Obligation:** 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 here:

[wecare.illinois.edu/resources/students/#confidential](http://wecare.illinois.edu/resources/students/#confidential).

Other information about resources and reporting is available here: [wecare.illinois.edu](http://wecare.illinois.edu).

**Academic Integrity:** The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

**Religious Observances:** Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the [Request for Accommodation for Religious Observances](#) form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.