Experiment I: Austenite Transformations
Objective: Construct a TTT curve for a medium alloy steel (4340). Conduct heat treatments, then perform metallography, optical microscopy, SEM, and hardness measurements.

Experiment II: Cold rolling, recovery, recrystallization, grain growth and texture of brass
Objective: Cold roll a brass bar, and quantify its recovery, recrystallization, grain growth, and texture. Test the Hall-Petch relationship. Perform metallography, optical microscopy, XRD, and hardness measurements.

Experiment III: Severe plastic deformation
Objective: Measure the effect of severe plastic deformation on alloy stability and grain size, and relate the properties of the alloy to its microstructure. Perform ball milling, glass tube sealing, XRD, and DSC.

Course evaluation:

1. Reports (66%): Groups will turn in one lab report for each experiment. Each lab report has equal weight. Lab reports are due one week after the conclusion of the experiments, unless otherwise specified. Late submissions will be penalized by 20% for each day late.
2. Quizzes (18%): Pre-lab quizzes will be due on the day before the first day of experiment (except the first experiment which is due on 1/31).
3. Participation (16%): Participation will be evaluated based on the completion of a daily work during the lab period. Each student should keep a lab notebook. The instructor will inspect the notebook, from time to time, and possibly grade it. (not really, but you should do it)

Late reports/quizzes will be accepted only with the instructor’s prior consent.
Reports

A substantial fraction of the grade in MATSE 404 will be determined by your reporting skills. It has been shown that learning through writing and speaking can be substantial and long-lasting. Moreover, it provides a simple means for evaluating your performance. A writer or speaker is not born “good”, and one of the objectives of this course is to improve your writing and speaking skills. The final words are only part of the reporting experience. Not only grammatical skill, but also organization, background research, judgement of relevance, a clear idea of the message to be transmitted, logical sequencing and motivation of the reader or listener are all important parts of a successful report. Of course, thoughtful, accurate and complete observations and data-taking must be the basis of any good lab report. Review the following format guidelines:

1. The length should be a maximum of 8 pages (including figures); supplementary figures, tables and such can and should be attached as an appendix. Be concise!
2. The text should be written in sections, each with a label; e.g., Purpose, Methods, Results, Conclusions
3. The style should be informative but not tutorial; you should assume the reader knows the subject at least as well as you but does not know the details of what you have done or the results. Thus, you must include the uncertainties in the measurements, and draw conclusions. You should include an outline of the experiment or test and your method of analysis.
4. The style of writing should be formal. This means:
   • Entire report written in 3rd person
   • Experimental section written in the past tense
   • Proper English
5. Figures/Micrographs: All micrographs must have a clear scale marker, indicating the magnification. Arrows and labels may be used to point out specific features you wish to discuss. Any text on a figure must be clearly legible. Carefully consider the best way to present large/multiple sets of data so that they can be easily be understood by the reader.
6. Captions: All figures, tables, and graphs should be labeled and have an appropriate caption, see example below. You can then refer to the figures in the text, e.g., “Carbides form on the boundaries due to heating at 500 °C, as shown in Figure 1.”—Captions can be of any length.

Figure 1. 1040 steel showing sensitization of the grain boundary structure. (A) MnC carbides formed on grain boundaries and (B) undissolved MnC still within the grains.
COURSE OBJECTIVES.

1. To learn specific principles of metals processing through laboratory investigation but, equally important, to learn proper experimentation, proper use of instruments, and respect for safety.
2. To 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.
3. To practice organization of large bodies of material into logical, concise, and accurate reports.

Read carefully the following points:

1. Stay safe during pandemic! The safety and well-being of our community is our number one priority.
   - In order to participate in class activities, students should follow standard testing protocols to maintain testing compliance.
   - Everyone should monitor themselves for symptoms of illness and stay home if not feeling well.
   - Masks or appropriate face coverings will be required at all times while indoors.
   - Food & Drink are not allowed in the building.
   - Obey all posted signs and rules.

2. Work safely! Always wear your safety glasses in the lab. Use appropriate additional personal protective equipment when necessary (thick vinyl gloves for handling acids and etchants). Do not work alone while in the lab. Anticipate potential dangers!
   - If you think something is unsafe – **Stop work immediately**
   - If you think someone else is doing something unsafe – **tell them to stop work immediately**.

3. Clean up once you are done! This avoids potential hazards and is an elementary rule of politeness.

4. Read the lab handout thoroughly and come to lab prepared. If you must acquire data, know what you are measuring. If you must make observations, know what to look for.
   - The quizzes have been added for this purpose

5. Understand the objective of the experiment, and ask questions if the experiment handout sheet is not sufficiently explicit.

6. Read the cited references **before** beginning to write your report. Better yet, read them before doing the experiment.

7. Pay attention while in the lab. Write down observations beyond those required in the lab handout – such as unexpected instrument operation; they might be helpful in understanding your results.

8. Keep a lab notebook: do not take data on scraps of paper or the experiment handout sheet unless this is intended. Be organized and legible. Date all notes and data.

9. Analyze your data during and soon after the experiment. Do not wait until the night before the report is due to find out that your data are incomplete, or worse, unreliable.

10. Try to interpret your observations or your data as you are taking it, but be careful to avoid bias. **Record what an instrument reads and not what you think it should read. It is unethical to do otherwise.** If corrections are necessary, make them subsequently and justify them.

11. Ask questions if:
   - You think something is unsafe
   - you are uncertain about the purpose of the experiment:
   - you are not sure what you should do
   - you do not know how to use the equipment
   - you think something has gone wrong

12. Use your instructor, other faculty, and your lab TA as resources during the experiment and for your report.

13. Carefully **proof-read reports** before submission. Careless work will not be tolerated. If you are going to make a mistake, it must not be from lack of effort. Remember to run a spelling and grammar check!
COVID

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community, including wearing a facial covering properly, maintaining social distance (at least 6 feet from others at all times), disinfecting the immediate seating area, and using hand sanitizer. Students are also required to follow the campus COVID-19 testing protocol.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

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 will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (https://studentcode.illinois.edu/article1/part4/1-404/). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: https://studentcode.illinois.edu/article1/part4/1-401/. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/. Ignorance of these policies 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.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the instructor.