

UNIVERSITY OF ILLINOIS  
Grainger College of Engineering  
Department of Materials Science and Engineering

Fall 2021: **MSE 443**  
**DESIGN OF ENGINEERING ALLOYS**

Instructor: Pascal Bellon, 312D MSEB, 265-0284, [bellon@illinois.edu](mailto:bellon@illinois.edu)  
Lecture: MWF 9-9:50 am, Siebel Center 1109 (+lecture capture at <https://echo360.org>)  
Office Hours: Pascal Bellon: appointment (+Zoom)  
Websites: <https://compass2g.illinois.edu/> ; [www.piazza.com](http://www.piazza.com)

Assigned textbook: **Structure and properties of engineering alloys**, W. F. Smith, 2<sup>nd</sup> Edition.  
620.16 SM68S1993 (Engineering reserve)

Recommended books:

- ASM Handbook**, Desk Edition and vols. 1-20, Q.669.1Am35mabr (online at <https://dl-asminternational-org.proxy2.library.illinois.edu/handbooks>);  
**Steels**, R.W.K. Honeycombe & H.K.D.H. Bhadeshia, 669.96142h757s1996 (online at <https://www.sciencedirect.com/book/9780081002704/steels-microstructure-and-properties>).  
**Materials Selection in Mechanical Design**, M. Ashby, 1992, 620.11AS34M (online at <https://www.sciencedirect.com/book/9781856176637/materials-selection-in-mechanical-design>)  
**Physical metallurgy handbook**, A. K. Sinha, 669.9 Si64p (reference).

Course Outline: 9 modules

1. Iron-carbon alloy system (Chaps 1 & 2)
2. Carbon and alloy steels (Chaps. 3 & 4)
3. Stainless steels (Chap. 7)
  
4. Copper alloys (Chap. 6)
5. Nickel alloys (Chap. 11)
6. Intermetallics and superalloys (class notes, Chap. 11)
  
7. Aluminum alloys (Chap. 5)
8. Titanium alloys (Chap. 10)
9. Refractory metal alloys (Chap. 13)

Grading: 10% Homework: 9/3; 9/17; 10/1; 10/15; 10/29; 11/12 (keep 5 best scores)  
10% Quizzes: 9/10; 9/24; 10/8; 11/5; 11/19 (keep 4 best scores)  
15% Term paper: On topic of your choice, in groups of 3 students  
25% mid-term exam: Friday 10/22, 9:00-9:50 am (during class session)  
40% Comprehensive final exam: Thursday 12/16, 1:30 to 4:30 pm

## ACTIVE LEARNING APPROACH

### 1/ Learning is an interactive process

- Ask and answer questions.

### 2/ Come prepared to class

- Read and reflect on assigned reading in textbook before lecture; prepare and post questions and answers on Compass for reading assignments, use Piazza for other course-related questions.
- Read and study assigned articles and questions.

### 3/ Participate actively during online Zoom classes

- Share with the class your knowledge and interests in certain alloys and applications.

## GRADING POLICIES

You are expected to have read the Student Code section related to Academic Integrity ([http://admin.illinois.edu/policy/code/article1\\_part4\\_1-401.html](http://admin.illinois.edu/policy/code/article1_part4_1-401.html)). All infractions listed in the Student Code, including cheating and plagiarism, will result in penalties in accordance with the Student Code. If you have any question regarding what constitutes an infraction, contact me.

## QUIZZES

There will be 5 quizzes throughout the semester (roughly one every two weeks), all taking place on Friday. You will take these quizzes in-person in class, during the first 20 minutes of the class session of that day. Your overall quiz grade will be the average of your 4 best scores.

## HOMEWORK ASSIGNMENTS

There will be 6 homework assignments throughout the semester (roughly one every two weeks), each due on Friday by 5 pm. Late assignment will not be graded. You will complete these assignments through the Compass website. Your overall assignment grade will be the average of your 5 best scores.

## GROUP PRESENTATION

15% of the grade of this course will be based on a poster presentation, each group comprised of 3 students. You are free to choose your group members. The topic of your presentation should be specific and well defined, with a focus on alloy developments, or materials selection, or novel processing, characterizing, and manufacturing techniques. You will have access to two software: 1/ CES, developed by Mike Ashby and collaborators at Granta Design and 2/ Thermo-Calc; CES will be accessed through Webstore, and Thermo-Calc using FastX from EWS (<https://fastx.ews.illinois.edu/auth/ssh>) using a campus connection or a VPN connection from off-campus. Then start a mate session and:

- \* Click on "Software Modules" on the top bar
- \* Run "module load thermocalc"
- \* Run "Thermo-Calc.sh"

Your topic will need to make some contact with we will cover in class this semester. Each group will need my approval to make sure that the topics are well defined and there is no overlap. The presentations will be scheduled for the last week of the semester. You will **not** have to write a paper in addition to giving your presentation.

Possible General Topics (you will need to focus on one specific point):

- Additive manufacturing applied to metallic materials
- Materials Genome Initiative and Integrated Computational Materials Engineering (ICME) ([http://www.whitehouse.gov/sites/default/files/microsites/ostp/materials\\_genome\\_initiative-final.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ostp/materials_genome_initiative-final.pdf); <http://materialsinnovation.tms.org/docs/pdfs/ICMEProgress.pdf>)
- Materials selection, e.g., in musical (wind) instruments, for sports, space, medical...or other applications
- Critical alloying elements ([http://energy.gov/sites/prod/files/DOE\\_CMS2011\\_FINAL\\_Full.pdf](http://energy.gov/sites/prod/files/DOE_CMS2011_FINAL_Full.pdf))
- Novel materials processing techniques, e.g., joining by friction stir welding.
- Advanced characterization techniques, e.g., electron backscattered diffraction (EBSD), atom probe tomography (APT).  
Advanced steels or cast irons
- Advanced superalloys for jet engines
- Advanced magnesium alloys for automotive applications
- Role of materials recycling in materials selection

### EXAMS

There will be a 50-minute mid-term exam on Friday 10/22 during the normal class time, and a final exam on Wednesday 12/16 from 1:30 to 4:30 pm (per University schedule for final exams). These exams will be in-person exams.

### COVID

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community. Students are also required to follow the campus COVID-19 protocols. 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.

All students, faculty, staff, and visitors are required to wear face coverings in classrooms and university spaces. This is in accordance with CDC guidance and University policy and expected in this class. Please refer to the University of Illinois Urbana-Champaign's COVID-19 website for [further information on face coverings](#). Thank you for respecting all of our well-being so we can learn and interact together productively.

In order to implement COVID-19-related guidelines and policies affecting university operations, instructional faculty members may ask students in the classroom to show their Building Access Status in the Safer Illinois app or the Boarding Pass. Staff members may ask students in university offices to show their Building Access Status in the Safer Illinois app or the Boarding Pass. If the Building Access Status says "Granted," that means the individual is compliant with the university's COVID-19 policies—either with a university-approved COVID-19 vaccine or with the on-campus COVID-19 testing program for unvaccinated students.

Students are required to show only the Building Access Screen, which shows compliance without specifying whether it was through COVID-19 vaccination or regular on-campus testing. To protect personal health information, this screen does not say if a person is vaccinated or not. Students are not required to show anyone the screen that displays their vaccination status. No university official, including faculty members, may ask students why they are not vaccinated or any other questions seeking personal health information.

### **EMERGENCY RESPONSE RECOMMENDATIONS**

Emergency response recommendations can be found at the following website: <http://police.illinois.edu/emergency-preparedness/>. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. <http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/>.

### **ANTI-RACISM AND INCLUSIVITY**

The intent is to raise student and instructor awareness of the ongoing threat of bias and racism and of the need to take personal responsibility in creating an inclusive learning environment.

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

### **ADDITIONAL IMPORTANT TOPICS**

#### **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 Office. In turn, an individual with the Title IX 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. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

**Disability-Related 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, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

**Family Educational Rights and Privacy Act (FERPA)**

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 on FERPA.