



ENGR 311: Design with Materials

School of Engineering and Science
Spring 2023

Instructor: Professor Sarah Goodman

Canvas Course Address: <https://sit.instructure.com/courses/64238>

Course Schedule:

- Section A Lecture: Howe 303, Mon/Wed 10-10:50 am
- Section B Lecture: Howe 303, Mon/Wed 11-11:50 am

- Lab A
 - Design: Burchard 102, Tuesday, 11 am – 12 pm
 - Lab: Burchard 312/313/314, 12:10 pm – 1:50 pm
- Lab B:
 - Design: Burchard 514, Friday, 11 am – 12 pm
 - Lab: Burchard 312/313/314, 12:10 pm – 1:50 pm
- Lab C:
 - Design: Burchard 102, Thursday, 11 am – 12 pm
 - Lab: Burchard 312/313/314, 12:10 pm – 1:50 pm
- Lab D:
 - Design: Burchard 430, Thursday, 6:30 – 7:30 pm
 - Lab: Burchard 312/313/314, 7:40 pm – 9:20 pm

Prerequisite(s): CH 115 - General Chemistry I, ENGR 122 - Field Sust Sys Sens

Cross-listed with:

COURSE STAFF AND CONTACT INFORMATION

Course instructor: Professor Sarah Goodman (she/her)

Contact Info: sgoodman1@stevens.edu

Office Hours: Mondays 1-2 pm, Thursdays 3:30-4:40, Burchard 409

Teaching Assistant:

Xiao (Roy) Zhao (he/him)

- Lecture TA
- Contact: xzhao22@stevens.edu
- Office hours: 519 Mclean

Lab and Design Facilitators and Teaching Assistants are listed in the Course Staff Document on Canvas.

COURSE DESCRIPTION

Materials have been used as the enabling fabric of building our modern world, and are being developed to make our world to become smarter, safer, and sustainable. Through this course, students will be able to:

- (1) correlate the structure of materials with their properties engineered for important uses;
- (2) implement rational materials and process selection based on hands-on laboratory experience and through design workshop activities; and
- (3) create and evaluate materials-enabled product solutions that would impact our society through a semester-long open-ended design project.

STUDENT LEARNING OUTCOMES

Student Outcome 1: (Complex Engineering Problems) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

- Course Outcome 1.1: You are able to quantify and differentiate, with order of magnitude precision, typical ranges of physical properties (e.g. density, hardness, elastic modulus, and tensile strength) of metals, ceramics, and polymers.
- Course Outcome 1.2: You are able to identify materials based on: (a) primary bonding types such as covalent, ionic, and metallic and secondary bonding types; (b) crystal and/or amorphous structures; and (c) defect types naturally present and/or engineered in structures.
- Course Outcome 1.3: You are able to correlate how bonding types, structures, and defects of materials determine the materials' mechanical, electrical, optical, thermal, and chemical properties.
- Course Outcome 1.4: You are able to analyze diffusion through a solid as its material property (e.g., gas permeability) using Fick's first law and as a processing mechanism to modify the solid (e.g., doping) using Fick's second law
- Course Outcome 1.5: You are able to explain the toughness of metals based on their plastic deformation and strengthening mechanisms in contrast to the brittleness of ceramics and the low-strength of polymers.
- Course Outcome 1.6: You are able to understand how highly controlled microstructures of metal alloys are produced using temperature, time, and alloy composition as major processing parameters.
- Course Outcome 1.7: You are able to: (a) compare how electrons and photons interact with conductors, semiconductors, and insulators based on their electron energy band

gap structures and (b) explain how dopants are used to produce extrinsic semiconductors as key building blocks of modern electronic devices.

- Course Outcome 1.8: You are able to analyze the development of thermal stress caused by thermal expansion and contraction of materials.
- Course Outcome 1.9: You are able to describe and predict the influence that common processing methods have on the structure and properties of example engineering materials

Student Outcome 2: (Design) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

- Course Outcome 2.1: You are able to evaluate the suitability of an engineering material for a particular application given specific design parameters and testing methodologies
- Course Outcome 2.2: You are able to design a materials specification suitable to propose and evaluate candidate materials for an engineered component.

Student Outcome 3: (Communication) an ability to communicate effectively with a range of audiences.

- Course Outcome 3.1: Students are able to demonstrate effective technical communications by developing and delivering both oral and written presentations appropriate to the audience and task.

Student Outcome 6: (Experimentation) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

- Course Outcome 6.1: You are able to: carry out standardized materials testing procedures required to characterize and compare the properties of engineering materials. Student

Outcome 7: (New knowledge) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

- Course Outcome 7.1: You are able to create authentic ideas, that address a significant contemporary challenge in our society, by applying the basic concepts of materials structure, properties, processing, and selection.

COURSE FORMAT AND STRUCTURE

This course is on-campus. To access the course, please visit stevens.edu/canvas . For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

This course has three parts:

- Lecture
- Design
- Lab

We will meet for lecture for 50 minutes twice per week, on Mondays and Wednesdays. Please attend either Section A from 10-10:50 am or Section B from 11-11:50 am. Lectures are led by the course instructor, Professor Goodman.

You are also registered for a 2 hour 50 minute lab section, which is split into two parts. The first hour is Design, which meets in a classroom in Burchard. During Design, you will work on case studies, design projects, and problem solving in which you will explore how the principles of materials processing we learn about in lecture relate to real-life situations. Design is led by your Design Facilitator.

There will then be a 10 minute break before you will head to the labs on the third floor of Burchard. For the next ~1 hour 40 minutes, you will conduct a hands-on experiment lead by a Teaching Assistant. Three rooms are listed as the location for the lab, because you will rotate classrooms throughout the semester. On the Lab Rotation document, you will find which room you will report to each week.

For example, your schedule will look like this if you are in Lecture Section B and Lab Section C:

- Monday
 - Lecture: Howe 303, 11-11:50 am
- Wednesday
 - Lecture: Howe 303, 11-11:50 am
- Thursday
 - Design: Burchard 102, 11 am – 12 pm
 - Lab: Burchard 312/313/314, 12:10 pm – 1:50 pm

COURSE SCHEDULE

Please see the course schedule at this link (also available on Canvas):

https://docs.google.com/spreadsheets/d/1EkspQNsGKd_FTdl6fY5GcpydW0n_LRd_wVbuBzblLto/edit?usp=sharing

Any changes will be made directly to this spreadsheet and will be announced in class.

COURSE MATERIALS

Textbook(s): W. Callister and D. Rethwisch, "WileyPLUS-Materials Science and Engineering: An Introduction," 10th Edition WileyPLUS, Wiley, ISBN- 9781119503910

Other Readings: To be posted on Canvas

Materials:

- Granta Edupack will be used extensively throughout this course. Please download it using the instructions posted on Canvas or access it through Apporto.

- Your textbook, as well as the homework problems, will be accessed via Wiley Plus. Please see the following video for instructions on how to register:
https://players.brightcove.net/4931690914001/default_default/index.html?videoId=6177746486001

COURSE REQUIREMENTS

Exams:

- We will have three exams, the dates of which are indicated on the course schedule.
- Together, the 3 exams will count for 40% of your grade.
- Each exam will cover approximately 1/3 of the course material.
- There is no final exam.

Homework:

- Homework will count for 15% of your grade.
- Every couple of weeks, you will be assigned problems to complete on Wiley Plus.
- Three attempts of each question are allowed, with links and hints always visible.
- 0% point reduction after first and second attempts
- 30% point reduction after third attempt.
- Late submission accepted with 50%-point reduction

Lab:

- The lab will count for 20% of your grade.
- Your lab grade will be composed of the following:
 - Attendance (0%) - Attendance will be taken. Anyone arriving >15 min late to the lab will not be permitted to take the pre-lab quiz, do the lab itself, or submit the Lab Notebook.
 - Pre-lab Quizzes (15%) - There will be a short quiz within the first 10 minutes of class to ensure that all students are familiar with lab objectives, procedures and safety concerns.
 - Lab notebook (75%) - In each lab session, each team will prepare a signed and dated electronic laboratory notebook (LN) entry, in which the team will record their data as well as answer some data analysis questions. The lab notebook must be completed and submitted by the end of the lab session.
 - One lab notebook will be submitted per team.

Design:

- The design part of the course will count for 20% of your grade.
- You will complete two design projects throughout the course of the semester, which you will primarily work on during Design.
- You will also analyze case studies, solve problems, and provide feedback to your peers during Design.
- Your Design grade will be composed of the following:
 - Participation (20%) – Work will be submitted at the end of each Design session.
 - Design Project I (40%) – This project will be completed in groups and will be due in mid-February.

- Design Project II (40%) – This project will be completed individually and will be due during the week of finals.

Lecture Participation:

- Lecture attendance will count for 5% of your grade.
- Attendance will be recorded during some but not all of the lectures. You can miss up to 4 lectures during which attendance was recorded without an impact on your grade.
- According to the Stevens Honor Board, falsifying attendance results in a zero for the attendance portion of the final grade: <https://web.stevens.edu/honor/documents/penalty-matrix.pdf>

TECHNOLOGY REQUIREMENTS

Required Software

- Granta Edupack (Please see instructions on Canvas for how to download Edupack)

GRADING PROCEDURES

Grades will be based on:

3 Exams – 40%

Homework – 15%

Lab – 20%

Design – 20%

Lecture participation – 5%

Late Policy

Exams

- If you miss an exam due to illness or emergency, please contact Xiao (Roy) Zhao and copy Professor Goodman to schedule a makeup exam.

Homework

- As outlined above, late homeworks will be accepted with a 50% point reduction

Labs

- If you miss a lab, please arrange with your TA to attend another lab section.

Design

- Late design project assignments will be accepted with a 5% point reduction per day late.

If you feel you are in a situation which would require an extension for an assignment, please contact Professor Goodman.

Assignment Policies

In any Lab or Design assignments, ALL work that you submit must be in your own words. Copying and pasting a direct quotation from another source is **not permitted**, even if those sources are accurately cited. The goal of Lab and Design assignments is for students to be able to develop their own understanding of how materials properties are measured, engineered, and utilized. Copying directly from other sources does not serve to meet that goal. All submitted work must include citations to any sources referenced.

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/>

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They

facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/office-disability-services>. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments can be made by phone (201-216-5177).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.