

Senior Design for Materials Science and Engineering/Metallurgical Engineering

Instructor:

- Jiaqi Jin, Assistant Professor, Materials Science and Engineering. jiaqi.jin@utah.edu

Organization:

- Spring Semester 2023: January 1st – April 27th
- Tuesday and Thursday 12:30 pm – 1:45 pm
- Classroom at GC 2660
- Zoom link for online sessions <https://utah.zoom.us/j/4408037628> (password: 2020)

Contents:

The Senior Design class is a capstone experience that focuses on design. Topics in different aspects of Materials Science and Engineering/Metallurgical Engineering will be selected by students for the Senior Design project. Students will work on their design projects independently but under the direction of a faculty member and an industrial advisor in the area of specialization. For graduating seniors only.

1. Fundamentals of Material and Process Design

Basics of material and process design, including material classes, process classes, design philosophies, cost analysis, and other considerations will be discussed in class.

2. Experience of Project Management and Development of Leadership

Professional trainings on leadership, teamwork, project management, presentation and communication skills will be offered to the students, during their process of completing the design projects under the supervision of academic and industrial advisors.

Class Schedule:

- Blue: 45 minutes lecture + 30 minutes group work
- Yellow: 1 hour 15 minutes lecture
- Green: group work
- Red: important dates

Tuesday, 1/10	Thursday, 1/12
Overview and Selection of Topics	Literature Review and SOW
Tuesday, 1/17	Thursday, 1/19
Teamwork and Leadership	Conversation about SOW
Tuesday, 1/24	Thursday, 1/26
Review of SOW	Matching Material and Process to Design
Tuesday, 1/31	Thursday, 2/2
Project Management	Preparing a Gantt Chart
Tuesday, 2/7	Thursday, 2/9

Tuesday, 2/14	Thursday, 2/16
Tuesday, 2/21	Thursday, 2/23
Project Update Presentation (4 groups)	Project Update Presentation (4 groups)
Tuesday, 2/28	Thursday, 3/2
	Writing of Interim Report
Spring Break	
Tuesday, 3/14	Thursday, 3/16
Capital Expense (online)	Operational Expense (online)
Tuesday, 3/21	Thursday, 3/23
Presentation Skills	Environmental Considerations
Tuesday, 3/28	Thursday, 3/30
	Project Update Presentation (4 groups)
Tuesday, 4/4	Thursday, 4/6
Project Update Presentation (4 groups)	Preparing Posters
Tuesday, 4/11	Thursday, 4/13
Friday, 4/14	
Senior Banquet (Poster Presentation)	
Tuesday, 4/18	Thursday, 4/20
Writing of Final Report	Interview and Negotiation
Tuesday, 4/25	Thursday, 4/27
Performance Evaluation	Senior Design Report Due Date

Assignments:

1. Background and Scope of Senior Design (Due 1/20)
2. Gantt Chart (Due 2/3)
3. Interim Report (Due 3/3)
4. Poster (Due 4/13)
5. Evaluation Forms (4/27)
6. Final Report (Due 4/27)

Topics to be Selected for Senior Design (4-5 students in each group):

Topic	Faculty Advisor	Industrial Advisor
Steel Manufacturing	Jiaqi Jin	Nucor
Gold Production	Jiaqi Jin	Nevada Gold Mines
Magnesium Production by Molten Salt	Michael Simpson	US Mag
Titanium Alloys	Zak Fang	IperionX
Ceramic Material in Battery	Ashutosh Tiwari	Storagenergy
Ga Metal for Semiconductors	Michael Scarpulla	5NPlus
Gypsum Dry-Wall	Xuming Wang	US Gypsum
Plastic	Chen Wang	3 Form
Hydrogel	Jeff Bates	Cooper Vision

ABET Outcomes:

- Primary Outcome 2 – 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.
- Primary Outcome 4 – An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- Secondary Outcome 3 – An ability to communicate effectively with a range of audiences.
- Secondary Outcome 6 – An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Engineering Design Defined by ABET:

Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade-offs, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

Questions to Think about the Senior Design Project:

1. What problems are you trying to solve with this material and process design?
2. What are the required properties of material produced in this design?
3. What elemental composition and/or microstructures will lead to the required properties?
4. What are the feed and process flowsheet to achieve the elemental composition and/or microstructures?
5. What are the throughput and cost of your designed process flowsheet?
6. What environmental impacts can be resulted from your design?

Grading:

- Class participation (2 points each lecture including senior banquet; 2 emergency leaves).
- Assignments (5 points each).
- Project updates or presentations (4 points each)
- Poster presentation at senior banquet (4 points, averaged score for each group member)
- Performance Evaluation (10 points, the self, peer, advisor, and instructor evaluation scores will be averaged).
- Grade scale: A: 90 – 100%, B: 80 – 89%, C: 70 – 79%, D: 60 – 69%, E: < 59%.

References:

- M. Ashby, H. Shercliff, D. Cebon, Materials: Engineering, Science, Processing and Design, 2018, Butterworth-Heinemann.

- M. Ashby, K. Johnson, Materials and Design: The Art and Science of Material Selection in Product Design, 2014, Butterworth-Heinemann.
- G. Dieter, L. Schmidt, Engineering Design: A Materials and Processing Approach, 2012, McGraw-Hill Higher Education.

Required Protocol for Exposure:

If you have been exposed, or are experiencing symptoms, self-report and follow university guidelines for exposure.

ADA Accommodations:

The University of Utah will continue to accommodate students, faculty, and staff through the Americans with Disabilities Act (ADA). Given the nature of this course, attendance is required and adjustments cannot be granted to allow non-attendance. However, if student needs to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA).