

## **ACAD-499 Advanced Materials**

**Units: 4**

**Spring 2025-MW-12:00- 1:50 pm**

**Location:** Materials Lab, IYH 107, Iovine & Young Hall, First Floor

**Instructor:** Sreejesh Moolayadukkam

**Office:** Materials Lab, IYH 107, 12-1.50 pm Monday, Wednesday

**Office Hours:** By appointment

**Contact Info:** moolayad@usc.edu

**IT Help:** <https://usc.edu.sharepoint.com/sites/IYASStudent/SitePages/IT-Resources.aspx>

**Hours of Service:** 8:30 a.m. – 6:30 p.m.

**Contact Info:** iyahelp@usc.edu

### **Course Description**

In the realm of engineering and design, a common challenge arises from the misalignment in technical language and conceptual frameworks, leading to complications in the execution of complex designs. The proposed course is meticulously crafted to address this gap, aiming to acquaint designers with the intricate concepts of materials science. The curriculum is thoughtfully curated, selecting materials science concepts and applications that are most pertinent to designers, thereby providing a foundational training. This course endeavors to equip students with a basic understanding of materials science, while also offering a comprehensive overview of emerging technologies and sustainability practices. Serving as an advanced materials course tailored for designers, it acts as a pivotal step towards exploring the vast domain of materials and fosters further specialization in this field.

### **Learning Objectives**

- Equip students with a solid foundation in materials science, ensuring they understand key concepts and the language used in both engineering and design contexts to facilitate smoother project executions.
- Provide a comprehensive overview of emerging technologies in materials science, enabling students to stay at the forefront of design innovation.
- Introduce sustainability practices within the realm of materials science, encouraging students to consider environmental impacts in their design choices.
- Foster an understanding of the importance of material selection in design, emphasizing the role of physical properties, cost efficiency, and environmental considerations in decision-making processes.
- Prepare students to further specialize in the field of materials science for design, setting the groundwork for advanced study or professional application in creating complex and sustainable designs.

**Prerequisite(s):** None

**Co-Requisite(s):** None

**Concurrent Enrollment:** None

**Recommended Preparation:** The course is based on the following references

Optional reference books:

Fundamentals of Materials Science and Engineering: An Integrated Approach, 5<sup>th</sup> edition, William D. Callister, 2015 ISBN: 9781119175483

Materials Selection in Mechanical Design, Fifth Edition, by Michael F. Ashby Burlington, MA: Butterworth-Heinemann, 2018.

The course slide deck will be available on the website.

## **Course Notes**

The course slide deck will be available on the website.

## **Required Readings and Supplementary Materials**

### **Optional Readings and Supplementary Materials**

Materials, or links to materials, will be distributed as needed

### **Description and Assessment of Assignments**

The following is a breakdown of the assignment expectations. Unless otherwise noted, all submissions will be in PDF format and will be due via email before the class session. If there are any changes, it will be communicated through email.

Assignments/projects

This can be individual or group activities, followed by mini-presentations and discussions in the classroom. The details about the assignments/projects and rubrics will be discussed in detail in the class and communicated over emails.

The final project will be a design challenge based on "Waste to use."

The evaluation is based on,

- Innovative thinking
- Materials selection
- Materials properties and explanations
- Final report/presentation/ prototype

Since the final project is based on Waste to use, no materials will be supplied, and the students are free to use the IYA facilities if required. If the students want to use any IYA facilities, they must be communicated to the faculty well in advance.

### **Participation**

Students are expected to be active participants in the classroom, for their own teams and projects, but also as advisors to the teams and projects of other classmates. The participation grade will be informed by active participation in class and observation of activities in small groups. Please note that attendance also carries 30% of the participation points.

## Grading Breakdown

**Table 1 Assessment Tool**

Assessment Tool (assignments)	Points	% of Grade
Assignments/mini projects/presentations (4)	400	40%
Final project	500	50%
Participation/Discussion/Attendance	100	10%
<b>TOTAL</b>	1000	100%

## Grading Scale

Course final grades will be determined using the following scale:

**Table 2 Course Grading Scale**

Letter grade	Corresponding numerical point range
A	100-94
A-	94-90
B+	90-87
B	87-83
B-	83-80
C+	80-77
C	77-73
C-	73-70
D+	70-67
D	67-64
F	64 or below

## Assignment Submission Policy

Unless otherwise noted, all assignments must be submitted as a PDF presentation. For assignments delivered in class (such as presentations), the work must be completed before the commencement of the class session in which the assignment is due. For assignments that are designated for virtual submission, one team member is expected to submit the assignment to [moolayad@usc.edu](mailto:moolayad@usc.edu) (unless otherwise specified) by 6:00 pm the day the assignment is indicated as due.

Assignments will be accepted after the deadline with the following grade penalties. Do not ask for extensions; below are the extensions.

- Submission in the 24 hours after the deadline 10% deduction
- Submission between 24 and 48 hours after the deadline 20% deduction
- Submission between 48 hours and 3 days after the deadline 50% deduction
- Submission more than 3 days after the deadline 100% deduction

## Grading Timeline

One week from the due date

## Course Specific Policies

## Attendance

The Academy maintains rigorous academic standards for its students and on-time attendance at all class meetings is expected. Each student will be allowed two absences over the course of the semester for which no explanation is required. Students are admonished to not waste excused absences on non-critical issues, and to use them carefully for illness or other issues that may arise unexpectedly. Except in the case of prolonged illness or other serious issue (see below), no additional absences will be excused. Each unexcused absence will result in the lowering of the final grade by  $\frac{1}{3}$  of a grade (e.g., an A will be lowered to A-, and A- will be lowered to a B+, etc.). In addition, being tardy to class will count as one-third of an absence. Three tardies will equal a full course absence.

Students remain responsible for any missed work from excused or unexcused absences. Immediately following an absence, students should contact the instructor to obtain missed assignments or lecture notes and to confirm new deadlines or due dates. Extensions or other accommodations are at the discretion of the instructor.

Automatically excused absences normally may not be used for quiz, exam or presentation days. Using an excused absence for a quiz, exam or presentation, such as in the case of sudden illness or other emergency, is at the discretion of the instructor.

In the case of prolonged illness, family emergencies, or other unforeseen serious issues, the student should contact the instructor to arrange for accommodation. Accommodation may also be made for essential professional or career-related events or opportunities. Additionally, students who need accommodations for religious observations should provide advanced notice to instructors and student athletes should provide Travel Request Letters. All accommodations remain at the discretion of the instructor, and appropriate documentation may be required.

Unless students provide an accommodation letter from USC's Office of Student Accessibility Services (OSAS) or a letter from IYA Student Services detailing visa or travel restrictions, attendance and active participation is expected in the classroom. Any student with such accommodations should submit their accommodation document to the instructor as soon as possible to discuss appropriate accommodations.

Students who are experiencing illness should not attend class in person. Please inform the instructor in advance of any class sessions that you can't attend for medical reasons, and accommodations will be arranged to view recorded lectures and submit alternatives to any missed class participation. Students will not be penalized for not attending class in person under these circumstances.

## Iovine and Young Hall Cleanout

The Academy is unable to store student projects and materials beyond the end of the semester. Students must remove all projects and personal materials from the Creators Studio, lockers/locker room, and other classrooms by the end of each semester. **All projects and materials left in Iovine and Young Hall will be discarded the day after final exams end. No exceptions.**

## Classroom norms

Students should wear appropriate lab attire on any lab days/field visits. The details about any special requirements will be emailed to the students before the class.

## Zoom etiquette

Guest lectures will be primarily via Zoom, and students are expected to be on camera and active in chat during discussions. If you are not able to make it to class, you should contact your team to arrange a Zoom meeting/room to allow you to collaborate with your team and others in a hybrid manner.

### **Academic Integrity**

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment or what information requires citation and/or attribution.

### **Use of AI Generators**

I expect you to use AI (e.g., ChatGPT and image generation tools) in this class. Learning to use AI is an emerging skill, and I welcome the opportunity to meet with you to provide guidance with these tools during office hours or after class. Keep in mind the following:

- AI tools are permitted to help you brainstorm topics or revise work you have already written.
- If you provide minimum-effort prompts, you will get low-quality results. You will need to refine your prompts to get good outcomes. This will take work.
- Proceed with caution when using AI tools and do not assume the information provided is accurate or trustworthy. If it gives you a number or fact, assume it is incorrect unless you either know the correct answer or can verify its accuracy with another source. You will be responsible for any errors or omissions provided by the tool. It works best for topics you understand.
- AI is a tool, but one that you need to acknowledge using. Please include a paragraph at the end of any assignment that uses AI explaining how (and why) you used AI and indicate/specify the prompts you used to obtain the results and what prompts you used to get the results. Failure to do so is a violation of academic integrity policies.
- Be thoughtful about when AI is useful. Consider its appropriateness for each assignment or circumstance. The use of AI tools requires attribution. You are expected to clearly attribute any material generated by the tool used.]

Please ask me if you are unsure about what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Group work: Unless specifically designated as a ‘group project,’ all assignments are expected to be completed individually.

If found responsible for an academic violation, students may be assigned university outcomes, such as suspension or expulsion from the university, and grade penalties, such as an “F” grade on the assignment, exam, or course.

### Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor’s permission will be presumed to be an intentional act to facilitate or enable academic dishonesty and is strictly prohibited. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

### Course Schedule

**Table 3 Course schedule**

	Session 1	Session 2
1	01/13 Cover syllabus Lab-specific safety training Introduction Project brainstorm 1	01/15 Interactive session with material scientists/researchers (Group activity) Group discussion
2	01/20 No class – Martin Luther King’s Birthday Holiday Report on the interaction with materials scientists/researchers	01/22 Structure of materials 1 Atomic structure and bonding Structure of crystalline solids Report out and discussion: Materials science and design gaps to bridge (Assignment 1)
3	Structure of materials 2 Assignment: Crystal structure with sustainable materials	Structure of materials 2 Assignment: Continue working on the project
4	01/27 Mechanical properties and failure of materials 1 Case study 1	01/29 Mechanical properties (continuation) Lab activity Assignment 2: report out
5	02/03: Mechanical properties and failure of materials 2 Project brainstorm 2	02/05: Field visit: Mechanical testing facilities Lab activity
6	02/10: Electronic properties of materials	02/12: Thermal properties of the materials

	Case study materials and design Lab	Case study materials and design
7	02/17 Holiday, No class – President’s Day Holiday	Magnetic and optical properties of materials Working on assignment and report 3
8	02/24: Material characterization techniques Lab: UV-Visible spectroscopy and its theory	02/26: Field visit: Material characterization facilities
9	03/03: Properties and application of metals and alloys Continue working on the project	03/05: Properties and application of metals and alloys Continue working on the project
10	03/10: Properties of polymers Basic building structure of polymers Lab activity	03/12: Processing of polymers and applications Lab activity
11	Spring Recess: 3/16-3/23	
12	03/24: Composite materials: Assignment: Understanding composites	03/26: Applications of the composites Continue working on the assignment
13	03/31: Sustainability guest lecture and discussion	04/02: Sustainable materials Assignment 4 report out (group)
14	04/07: Introduction to Nanotechnology Lab activity: Lab visit	04/09: Applications of nanotechnology
15	04/14: New materials Working on the final project	04/16: Energy storage and energy harvesting Working on the final project
16	04/21: Final project	04/23: Final project
	Final presentation:	05/09: 11 am to 1 pm

## Statement on University Academic and Support Systems

### **Students and Disability Accommodations:**

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](https://osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

### **Student Financial Aid and Satisfactory Academic Progress:**

To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the [Financial Aid Office webpage](#) for [undergraduate-](#) and [graduate-level](#) SAP eligibility requirements and the appeals process.

### **Support Systems:**

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-2500

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.