AME 518: Emerging Manufacturing Technologies

Units: 4
Term: Fall 2024
Day-Time: Mon/Wed 10-11:50 am

Location: WPH 206

Instructor: Hangbo Zhao
TA: TBD
Office: OHE 430S
Office Hours: TBD
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Course Description

This course presents an overview of several emerging manufacturing technologies across different length scales (macro-micro-nano). The topics include top-down approaches such as lithography-based semiconductor manufacturing and laser manufacturing, bottom-up approaches such as 2D and 3D printing processes and material synthesis/assembly. For each of the topic, we will provide technology overview, working principles, current state of the technology, and examples of applications where technology is being used. This course is intended for students interested in learning emerging manufacturing technologies and/or developing new ones.

Learning Objectives

This course aims at providing a comprehensive understanding of selected emerging manufacturing techniques. After completing this course, students should be able to:
(a) Understand the working principles of different manufacturing processes
(b) Compare different manufacturing processes and identify best processes for specific applications
(c) Articulate key process conditions and their impact on material/structure properties
(d) Gain a comprehensive perspective of latest developments of these manufacturing processes
(e) Gain hands-on experience in the design, simulation, and fabrication using 3D printing

Grading Option

Letter grade.

Technological Proficiency and Hardware/Software Required

N/A.

Required Readings and Supplementary Materials

There is no required textbook for this course. Lecture notes and readings will be posted on Blackboard. The following books are helpful resources:

[1] "*Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*", M.P. Groover, Seventh Edition, Wiley, 2019. ISBN: 978-1-119-47521-7

[2] "*Fundamentals of Microfabrication: The Science of Miniaturization*", M.J. Madou, Second Edition, CRC, 2002. ISBN: 978-0849308260.

[3] "*Design for Advanced Manufacturing: Technologies and Processes*", L.K. Gillespie, First Edition, McGraw-Hill Education, 2017. ISBN: 978-1259587450.

[4] "*Additive Manufacturing Technologies*", I. Gibson, D. Rosen, B. Stucker, M. Khorasani, Third Edition, Springer, 2021. ISBN: 978-3030561260.

Grading Breakdown

Homework   35%
Midterm exam   30%
Final project   35%

Course Notes

• There will be a total of 5 homework assignments.
• Discussion of homework assignments with your classmates is encouraged, but each student is required to submit their own solutions.

Final Project Guidelines

Students will form teams (up to 4 students in a team) to design, print, and test an egg lander using 3D printing. The final project consists of a proposal (5%), presentation (10%), live demonstration score (15%), and a written report (5%), to be completed by each team. Each student's final project grade is based on a combination of the team's deliverables

and presentation as well as the student's individual effort. 3D printers and materials will be provided by the Center for Advanced Manufacturing.

Academic Integrity

Unless otherwise noted, this course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). The general USC guidelines on Academic Integrity and Course Content Distribution are provided in the subsequent "Statement on Academic Conduct and Support Systems" section.

Please ask the instructor [and/or TA(s)] if you are unsure about what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

You may not record this class without the express permission of the instructor and all other students in the class. Distribution of any notes, recordings, exams, or other materials from a university class or lectures — other than for individual or class group study — is prohibited without the express permission of the instructor.

Use of AI Generators Policy

Since creating, analytical, and critical thinking skills are part of the learning outcomes of this course, all assignments should be prepared by the student working individually or in groups. Students may not have another person or entity complete any substantive portion of the assignment. Using AI-generated tools is prohibited in this course, will be identified as plagiarism, and will be reported to the Office of Academic Integrity.

Tentative Course Schedule

Week	Topics	Deliverable/ Due dates
1	Introduction to manufacturing Review of conventional manufacturing processes	
2	Structures of engineering materials Physical properties of engineering materials	
3	Manufacturing of microelectronics: I	HW 1
4	Manufacturing of microelectronics: II Manufacturing of microelectronics: III	
5	Unconventional lithography: electron beam, multi photon Unconventional lithography: soft lithography, nanoimprint	HW 2
6	Micro molding Micro stamping and hot embossing	
7	2D printing processes: flexography, inkjet printing 2D printing processes: electrohydrodynamic printing	HW 3
8	2D printing processes: transfer printing Midterm review	
9	Midterm exam Laser manufacturing processes: I	
10	Laser manufacturing processes: II 3D printing (additive manufacturing) processes: I	HW 4
11	3D printing (additive manufacturing) processes: II 3D printing (additive manufacturing) processes: III	
12	Self-assembly Micro/nano manipulation	HW 5 Final project proposal
13	Manufacturing of 0 and 1D nanostructures Manufacturing of 2D and 3D nanostructures	
14	Manufacturing of flexible electronics	
15	Final course project presentations	Final project presentations
FINAL	Final project reports	Refer to the USC Schedule of Classes at classes.usc.edu

Statement on Academic Conduct and Support Systems

Academic Integrity:
The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

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

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

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.

Contact information:
Academic Conduct
Office of Academic Integrity – (213) 764-4163
Academicintegrity.usc.edu

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.

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 relationship to the class, whether obtained in class, via email, on the internet, or via any other media. (Living our Unifying Values: The USC Student Handbook, page 13).

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. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

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 is comprised 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) 740-5086 or (213) 821-8298
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
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.