



## **AME 599: Emerging Manufacturing Technologies**

**Units: 4**

**Term: Fall 2022**

**Day-Time: M/W 10:00-11:50 am**

**Location: CPA 252 and Zoom**

**Instructor: Hangbo Zhao**

**Office: OHE 430S**

**Office Hours: TBD**

**Contact Info: [hangbozh@usc.edu](mailto:hangbozh@usc.edu)**

## 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

**Prerequisite(s):** None

## Course Notes

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.
- [2] *"Fundamentals of Microfabrication: The Science of Miniaturization"*, M.J. Madou, Second Edition, CRC, 2002.
- [3] *"Design for Advanced Manufacturing: Technologies and Processes"*, L.K. Gillespie, First Edition, McGraw-Hill Education, 2017.
- [4] *"Additive Manufacturing Technologies"*, I. Gibson, D. Rosen, B. Stucker, Second Edition, Springer, 2014.

## Grading Breakdown

Homework	35%
Midterm exam	30%
Final project	35%

## Assignment Submission Policy

- 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.
- The final projects will be team-based studies of certain manufacturing topics. More details will be provided later.

## Tentative Course Schedule

Week	Topics	Deliverable/ Due dates
1	M (8/22): Introduction to manufacturing W (8/24): Review of conventional manufacturing processes	
2	M (8/29): Structures of engineering materials W (8/31): Physical properties of engineering materials	
3	M (9/5): Labor Day, no lecture W (9/7): Manufacturing of microelectronics: I	HW 1
4	M (9/12): Manufacturing of microelectronics: II W (9/14): Manufacturing of microelectronics: III	
5	M (9/19): Unconventional lithography: electron beam, multi photon W (9/21): Unconventional lithography: soft lithography, nanoimprint	HW 2
6	M (9/26): Micro molding W (9/28): Micro stamping and hot embossing	
7	M (10/3): 2D printing processes: flexography, inkjet printing W (10/5): 2D printing processes: electrohydrodynamic printing	HW 3
8	M (10/10): 2D printing processes: transfer printing W (10/12): Midterm review	
9	M (10/17): Midterm exam W (10/19): Laser manufacturing processes: I	
10	M (10/24): Laser manufacturing processes: II W (10/26): 3D printing (additive manufacturing) processes: I	HW 4
11	M (10/31): 3D printing (additive manufacturing) processes: II W (11/2): 3D printing (additive manufacturing) processes: III	
12	M (11/7): Self-assembly W (11/9): Micro/nano manipulation	HW 5
13	M (11/14): Manufacturing of 0 and 1D nanostructures W (11/16): Manufacturing of 2D and 3D nanostructures	
14	M (11/21): Manufacturing of flexible electronics W (11/23): Thanksgiving Holiday, no lecture	
15	M (11/28): Robotics and automation in manufacturing W (11/30): Final project presentations	

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

### Support Systems:

*Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call*

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. [engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

*National Suicide Prevention Lifeline – 1 (800) 273-8255*

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. [www.suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org)

*Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call*

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. [engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

*Sexual Assault Resource Center*

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: [sarc.usc.edu](http://sarc.usc.edu)

*Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086*

Works with faculty, staff, visitors, applicants, and students around issues of protected class. [equity.usc.edu](http://equity.usc.edu)

*Bias Assessment Response and Support*

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. [studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

*The Office of Disability Services and Programs*

Provides certification for students with disabilities and helps arrange relevant accommodations. [dsp.usc.edu](http://dsp.usc.edu)

*Student Support and Advocacy – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. [studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

*Diversity at USC*

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. [diversity.usc.edu](http://diversity.usc.edu)

*USC Emergency Information*

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. [emergency.usc.edu](http://emergency.usc.edu)

*USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.*

Provides overall safety to USC community. [dps.usc.edu](http://dps.usc.edu)