ISE232L/AME232L: Manufacturing Processes

Units: 4
Fall 2024 — Tuesday & Thursday, 4:00 – 5:50 pm

Location: DMC 157

Instructor: Yong Chen
Office: OHE 430E
Office Hours: Tuesday & Thursday (2 – 3:30 pm)
Contact Info: yongchen@usc.edu, 213-740-7829.
Timeline for replying to emails/calls: within 48 hours.

Teaching Assistant: TBA
Office: GER242
Office Hours: TBD
Contact Info: TBD.

USC Catalogue Description

This course aims to provide students an understanding of manufacturing engineering and technology, and
the interrelationship between manufacturing processes, product design and material properties.

Course Description

This course aims to provide students with an understanding and appreciation of the breadth and depth of
the field of manufacturing engineering, and the strong interrelationships between manufacturing
processes, product design and material properties. It will introduce traditional manufacturing processes
such as casting, forming, lathing, milling, polymer injection molding, and emerging manufacturing processes
such as layer manufacturing, electronic device fabrication, and MEMS manufacturing. It will also discuss
modern digital technologies used in manufacturing engineering, such as computer-aided design and
engineering, computer-numerical control, and three-dimensional (3D) printing. Group projects are designed
to prepare the students to understand how everyday products are designed, prototyped, and
manufactured.

Learning Objectives

This course is a combined lecture and laboratory teaching. The lectures will consist of seven parts: (1)
Manufacturing processes and their relations to product design and material properties, (2) metal
component manufacturing; (3) plastic component manufacturing; (4) digital product design and
manufacturing; (5) prototyping and additive processes; (6) semiconductor and micromanufacturing; and (7)
manufacturing of complex products and manufacturing systems. Various case studies and related videos
will be used in the lectures. The Labs will require students to form teams to design and prototype an
innovative device using the provided CAD software systems and 3D printers. The course outcomes for a
student are:

• Gain an understanding of the objectives, constraints, and basic processes of manufacturing.
• Gain an understanding of which types of manufacturing processes are suitable for which materials,
  and for various quantities of production.
• Gain an understanding of the basic range of materials used in manufacturing, and the appropriate
  uses and applications of these various materials.
• Gain an understanding of the difference between forming, subtractive, and additive manufacturing
  processes and when each might be suitable.
• Gain hands-on experience with several materials and production / forming processes.
• Obtain an introduction to the practical issues, constraints, and other factors that can affect manufacturing processes. Supplement this knowledge through visits to lab facilities.
• Obtain experience working in small teams through student projects and demonstrations.

Prerequisite(s): None

Recommended Preparation: An introductory course on material science (e.g., MASC 110L) or chemistry (e.g., CHEM 105aL or CHEM 115aL) is desired.

Course Notes
The course grading type is Letter. The course is web-enhanced using Blackboard. Copies of lecture slides and other class information will be posted on Blackboard each week. The course is a combined lecture and laboratory teaching. In the labs, the students will be required to use provided CAD software systems and 3D printers.

Technological Proficiency and Hardware/Software Required
The students are desired to have a laptop that can install provided software systems.

Required Readings and Supplementary Materials

Description and Assessment of Assignments
The course will have the following assessment tools:

Problem Assignments: Students will be given reading assignments and homework assignments (including labs) from the textbook. Homework assignments should be turned in promptly. They should demonstrate that the student has thoughtfully considered the material presented and its value. Half of the points will be deducted for late submissions.

Lab Quiz: One quiz will be given based on lab teaching in the first half of the semester.

Midterm exam: One midterm examination will be given in the middle of the semester.

Final Exam: One final examination will be given at the end of the semester based on the university’s final exam schedule.

Lab & Course Projects: The objective of the class projects is to help the students gain hands-on experience and use learned materials to solve real world problems. Each project team will have 3 students, who are expected to work together to accomplish the given tasks.

1. In the course project, each team is expected to dissect an everyday product and analyze the manufacturing processes and material of its components.

2. In the lab project, each team is expected to develop an innovative product related to the course project. A functional prototype and its CAD models need to be built and demonstrated at the end of the project.

Each project team must prepare a presentation for each project to explain their ideas, methods, and results to the class. Presentations will take about 10 minutes per team, and the presenters should be prepared to answer questions on the topic. The presentation and a project report will be used in the evaluation of team-based grades.
**Participation**: Participation in the classes and labs is required and will be considered.

**Grading Breakdown**

The grading for the class will be determined using the following weights:

<table>
<thead>
<tr>
<th>Assessment Tool (assignments)</th>
<th>Points</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem assignments</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Lab Quiz</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>Midterm exam</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Final exam</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Lab project</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Course project</td>
<td>100</td>
<td>15</td>
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<tr>
<td>Participation</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Grading Scale**

Course final grades will be determined using the following scale:

- **A**: 95-100
- **A-**: 90-94
- **B+**: 87-89
- **B**: 83-86
- **B-**: 80-82
- **C+**: 77-79
- **C**: 73-76
- **C-**: 70-72
- **D+**: 67-69
- **D**: 63-66
- **D-**: 60-62
- **F**: 59 and below

**Assignment Submission Policy**

Most assignments are to be submitted using the Blackboard system. The submission deadline will be set for the assignments and shown in the Blackboard system.

**Grading Timeline**

The standard timeline for grading and feedback is generally within a week after submission.

**Additional Policies**

Additional policies that students should be aware of: Participation in the classes and labs is required and will be taken into account. If you will miss a class, please let me know in advance and work with your fellow students to catch up on what you miss. Please turn cell phones and pagers off or put them in vibrate mode before coming to the classes and labs.
### Tentative Course Schedule: A Weekly Breakdown (subject to change)

**IMPORTANT:**
In addition to in-class contact hours, all courses must meet a minimum standard for out-of-class time, which accounts for time students spend on homework, readings, writing, and other academic activities. Standard fall and spring sessions (001) require a final summative experience during the University's scheduled final exam day and time.

<table>
<thead>
<tr>
<th>Week</th>
<th>Activities (Tuesday)</th>
<th>Topics/Daily Activities (Thursday)</th>
<th>Readings/Preparation</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Course introduction &amp; Manufacturing background</td>
<td>Product development, Project overview &amp; Team forming</td>
<td>Ch1</td>
<td>Team Formed</td>
</tr>
<tr>
<td>2</td>
<td>Lab 1 – CAD system introduction &amp; Visit Viterbi Maker Space</td>
<td>Project idea discussion &amp; Mechanical properties</td>
<td>Ch2</td>
<td>Project Assigned</td>
</tr>
<tr>
<td>3</td>
<td>Physical properties &amp; Engineering materials (Metal)</td>
<td>Engineering materials (Polymer &amp; ceramics &amp; composites)</td>
<td>Ch3, 5, 6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Project Idea Presentation &amp; Course project discussion &amp; Manufacturing process overview</td>
<td>Lab 2 CAD I</td>
<td>Ch7</td>
<td>Project Idea Due</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dissection Project Assigned</td>
</tr>
<tr>
<td>5</td>
<td>Metal casting</td>
<td>Polymer injection molding</td>
<td>Ch10-12</td>
<td></td>
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<tr>
<td>6</td>
<td>Forging &amp; Sheet-metal forming</td>
<td>Lab 3 CAD II</td>
<td>Ch19</td>
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<tr>
<td>7</td>
<td>Lab 4 CAD III</td>
<td>Fall recess (no class)</td>
<td>Ch14, 16</td>
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<tr>
<td>8</td>
<td>Mid-term Exam &amp; Machining introduction</td>
<td>Dissection Project Presentation</td>
<td></td>
<td>Dissection Project Due</td>
</tr>
<tr>
<td>9</td>
<td>Lab 5 Lab Quiz</td>
<td>Cutting model &amp; Prototyping project discussion</td>
<td>Ch21, 23</td>
<td>Prototyping Project Assigned</td>
</tr>
<tr>
<td>10</td>
<td>Metal machining &amp; Intro to CAM &amp; CNC</td>
<td>Lab 6 CNC machining demonstration (Viterbi Maker Space)</td>
<td>Ch24</td>
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<tr>
<td>11</td>
<td>Intro to Rapid Prototyping, Rapid tooling &amp; 3D printing</td>
<td>Lab 7 Tour of Center for Advanced Manufacturing &amp; Rapid tooling demonstration</td>
<td>Ch37 &amp; 38</td>
<td>Product Sketch Due</td>
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<tr>
<td>12</td>
<td>3D Printing of polymers – SLA, SLS, FDM, 3DP</td>
<td>Lab 8 Design for 3D printing &amp; Prototyping project discussion</td>
<td>Ch20</td>
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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. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on Research and Scholarship Misconduct.

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

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

<table>
<thead>
<tr>
<th>Week 13</th>
<th>3D Printing of metal and ceramics</th>
<th>Semiconductor fabrication</th>
<th>Ch17, 28</th>
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<tbody>
<tr>
<td>(Nov. 18)</td>
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<tr>
<td>Week 14</td>
<td>MEMS &amp; Micromanufacturing</td>
<td>Thanksgiving Holiday</td>
<td>Ch29</td>
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<tr>
<td>(Nov. 25)</td>
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<td>(no class)</td>
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<tr>
<td>Week 15</td>
<td>Prototyping Project Presentation &amp; manufacturing systems &amp; Wrap-up</td>
<td>Prototyping project demonstration &amp; Tradeshows</td>
<td>Ch39&amp;40</td>
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<tr>
<td>(Dec. 2)</td>
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<tr>
<td>FINAL</td>
<td>Study day</td>
<td>Final exam</td>
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<td>(Dec. 7)</td>
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Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

eeotix.usc.edu

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

usc-advocate.symplicity.com/care_report

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.usc.edu

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) 821-4710

campussupport.usc.edu

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

diversity.usc.edu

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
dps.usc.edu, emergency.usc.edu

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) 442-120 – 24/7 on call
dps.usc.edu

Non-emergency assistance or information.

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

ombuds.usc.edu

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) 442-3340 or otpf@med.usc.edu

chan.usc.edu/otfp

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