

# COURSE SYLLABUS

## ME 137/237: 3D PRINTING FOR NON-TECHNICAL INNOVATORS

### Meeting Times & Location

Lectures	Wed	12:30 am-1:20 pm	Building 550	Room 200
Workshop Sessions	Fri	1:30 am-3:20 pm	Lathrop	Room 299

### Instructors

Larry Leifer	Email: <a href="mailto:leifer@cdr.stanford.edu">leifer@cdr.stanford.edu</a>
Lauren Aquino-Shluzas	Email: <a href="mailto:larenino@stanford.edu">larenino@stanford.edu</a>
Katherine Stephenson	Email: <a href="mailto:kstephenson@stanford.edu">kstephenson@stanford.edu</a>

### Class Assistant

Phillip Dupree	Email: <a href="mailto:pdupree@stanford.edu">pdupree@stanford.edu</a>
Betsy Soukup	Email: <a href="mailto:betsy.soukup@gmail.com">betsy.soukup@gmail.com</a>

### Prerequisite

A laptop. A desire to make something. That's it.

### Class Objectives

3D Printing is a method of creation that requires only some basic computer skills and a few rules of thumb. This class will allow students to discover for themselves the potential and limitations of 3D Printing through a build intensive design project. This course is an excellent option for anyone who ever wanted to prototype an invention, create a work of art, customize a product or just make something cool...and yet lacked the skills or a fully equipped workshop. Students may enroll for 1 unit to attend the weekly lecture or 3 units to attend the weekly lecture and workshop, and complete a course project. No prior technical knowledge needed.

Students can expect to be able to do the following by the end of the course:

For those who attend only the 1 unit seminar lectures:

- Be able to think critically about public reports of 3D printing in the media
- Be able to communicate clearly what makes 3D printing unique from other traditional methods of manufacturing and what its current benefits and limitations are.
- Be able to access specific resources needed to 3D print an object; include CAD software, CAD libraries, additional CAD and printing web tutorials, and 3D printing service providers.
- Complete online CAD tutorials independently, at their own pace.

For those who attend the additional weekly workshops and complete a project for 3 units of credit:

- Perform all steps necessary to 3D print a simple, custom object:
  - Be able to open, view, manipulate and edit three dimensional object files
  - To create new three-dimensional object files from scratch.
  - Prepare and optimize those files for 3D printing
  - Successfully fabricate the file design through a 3D printing service provider using appropriate material and method selections.

## Intended Student Audience

This course is intended for registered Stanford undergraduate or graduate students with minimal prior exposure to Computer Aided Drafting (CAD) or manufacturing technologies. It will be particularly useful to students outside of mechanical engineering and design who find themselves on a multi-disciplinary product design team, such as those in the business school or medical schools. Course auditors are welcome in the weekly lectures, if space is available.

## Class Reference Materials

- Internet Resources
  - Required:
    - Class Web-Page
      - <https://web.stanford.edu/class/me137/>
    - Coursework Homepage: <http://coursework.stanford.edu>
      - Slides from class
      - PDFs of in-class exercises
    - AutoDesk Fusion360 HomePage: <http://fusion360.autodesk.com>
- Recommended Further Resources
  - Books
    - Fabricated: The New World of 3D Printing by Hod Lipson and Melba Kurman
    - Design and Modeling for 3D Printing by Matthew Griffin
  - Free CAD Libraries
    - AutoDesk 123D Gallery: <http://www.123dapp.com/Gallery/content/all>
    - SketchUp Gallery: <https://3dwarehouse.sketchup.com/>
    - SolidWorks Gallery: <http://www.3dcontentcentral.com/default.aspx>
    - 3D Anatomy Models: <http://lifesciencedb.jp/bp3d/?lng=en>
    - Thingiverse by MakerBot: <http://www.thingiverse.com/>
    - Youmagine: <https://www.youmagine.com/designs>
  - Academic Journals on 3D Printing
    - Rapid Prototyping Journal (ISSN 1355-2546)
    - International of Rapid Manufacturing (ISSN 1757-8817)
    - Virtual and Physical Prototyping (ISSN 1745-2759)

## Course Policies and Expectations

- Students must apply to the project track of the class to be enrolled for 3 units. There is no application to attend the 1 unit seminar. The project track student list will be announced on the first day of class (March 30<sup>th</sup>).
- If taking 3 units, attendance at the Friday workshops is mandatory.
  - A significant part of the work effort of the class will be completed in the working sessions. You **MUST** attend the entire session.
  - Material in each session builds rapidly on the work from the previous week, so missed sessions must be made up before the next week's session.
  - If an absence, late arrival or early departure cannot be avoided, please contact the lead instructor ([kstephenson@stanford.edu](mailto:kstephenson@stanford.edu)) as early as possible to arrange suitable make up work.
- Laptops will be required for each working session.
  - If you do not bring your laptop to the workshop, you **CAN NOT** participate in the session and will have to arrange a make-up session.
  - Computer modeling is highly energy intensive. Please bring a power cable to plug your computer in during the work sessions. Computers will run slower on batteries.
- While laptops are necessary, cell phones are not. Please, keep them out of sight and muted.

- Everyone learns at a different speed.
  - While everyone will be completing the same tutorials during the work sessions, not everyone will complete them in the same time. Please be considerate of your classmates if you complete the work early.
- NO, you can NOT leave early if you finish the tutorial early.
  - The class will discuss the tutorial at the end of class time
    - Weekly feedback will help set the pace of the class and make sure everyone is learning.

## Assignments & Grading

Both the seminar and project tracks of the course are graded on a S/NC basis.

Regular attendance at the weekly lecture is the only requirement for 1 unit of class credit. One absence is allowed. Please contact the instructors if additional absences are unavoidable.

For 3 units of credit, each student must attend (in addition to the lecture) a 2-hour weekly workshop session and complete a team design project. The tutorials and project will consist of the following assignments:

• Completion of tutorial assignments	25	( 5 points each x 5 tutorials = 25)
• Team Project Idea Submission	5	
• First Project Part file	5	
• First Project Printed Part	10	
• Second Project Printed Part	10	
• Final Project CAD files	15	
• <u>Final Printed Project &amp; Presentation</u>	<u>30</u>	

100 points

The project assignments are structured to ensure that each team makes steady progress on the project throughout the quarter, with adequate time at the end of the quarter to allow for a variety of printing methods.

## Stanford Policies

- Use of Online Files:
  - Submitting 3D Solid files found online as the student's own work, either "As is" or with only minimal modifications, is NOT acceptable and will be considered plagiarism.
  - However, in this class and in design in general, designers will often download a basic file and modify it to fit their needs. Alternately, they may combine multiple 3D solid files to create a new design. Significantly modifying an existing file can be as difficult (if not more so) that creating a brand new one.
  - To avoid any possible risk of plagiarism, always cite the source for any file you use in your design. Be prepared to discuss your own creative contribution to the new design.
- Students with Documented Disabilities
  - Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: <http://studentaffairs.stanford.edu/oae>)

# Class Schedule

Week	Topic	Date	Day	Time	Room	HW
1	<b>LECTURE 1</b>	30-Mar	W	12:30	550-200	
	Course Outline					
	Cool Stuff Showcase					
	"Can you print it?" Game					
	Design 101: Design Process Overview					
	<b>WORKSHOP 1</b>	1-Apr	F	11:30 AM	Lathrop 299	
	Loading Fusion 360					
	The CAD Environment					
	Best Practices for Running CAD					
	Common CAD Files Types					
CAD Libraries						
2	<b>LECTURE 2</b>	6-Apr	W	12:30 PM	550-200	
	Tech Lecture: A Short History of Digital Manufacturing					
	Interactive Exercise: Design for 3D Print					
	<b>WORKSHOP 2</b>	8-Apr	F	11:30 AM	Lathrop 299	HW #1 Due
	Fusion 360 Modeling					
	Sketching					
	Extruding					
Collaborating on Files						
3	<b>LECTURE 3</b>	13-Apr	W	12:30 PM	550-200	
	Tech Lecture: Process Flow					
	Design Lecture: Empathize					
	<b>WORKSHOP 3</b>	15-Apr	F	1:30 PM	Lathrop 299	HW#2 Due
	Fusion 360 Sculpting					
	Moving between Environments					
Matching Imported Geometry						
4	<b>LECTURE 4</b>	20-Apr	W		550-200	
	3DP in Public Media 3					
	Tech Lecture: The 3DP Business Case					
	Design Lecture: Define					
	<b>WORKSHOP 4</b>	22-Apr	F	1:30 PM	Lathrop 299	HW#3 Due
	Working with Meshes					
	Scanning Tools					
	Editing Scanned Files					
Fixing Scan Bugs						
5	<b>LECTURE 5</b>	27-Apr	W	12:30 PM	550-200	
	Tech Lecture: Printing in Plastic					
	Design Lecture: Ideate					
	<b>WORKSHOP 5</b>	29-Apr	F	11:30 AM	Lathrop 299	HW#4 Due
	Optimizing for Print					

	Printing @ Stanford					
	Print De-Bugging					
<b>6</b>	<b>LECTURE 6</b>	6-May	W	12:30 PM	550-200	
	Tech Lecture: Printing in Metal					
	Design Lecture: Prototype I					
	<b>Workshop 6</b>	6-May		11:30 AM	Lathrop 299	HW# 5 Due
	Making Assemblies					
	Moving and Aligning Parts					
	Joints					
	Motion Studies					
<b>7</b>	<b>LECTURE 7</b>	11-May	W	12:30 PM	550-200	
	Tech Lecture: Printing in glass, wood, concrete & more					
	Design Lecture: Prototype II					
	<b>WORKSHOP 7</b>	13-May		11:30 AM	Lathrop 299	HW #6 Due
	Fasteners					
	Finishes					
	Advanced Modeling Tools					
<b>8</b>	<b>LECTURE 8</b>	18-May	W	12:30 PM	550-200	
	Tech Lecture: Bioprinting					
	Design Lecture: Test					
	<b>WORKSHOP 8</b>	20-May		11:30 AM	Lathrop 299	HW #7 Due
	Working with service providers					
	Optimizing Files for Different Methods					
	Debugging Prints					
<b>9</b>	<b>LECTURE 9</b>	25-May	W	12:30 PM	550-200	Final Design Files Due
	Tech Lecture: Politics & Ethics					
	Guest Speaker					
	<b>WORKSHOP 7</b>	27-May		11:30 AM	Lathrop 299	
	CAD Rendering					
	Mechanical Drawings					
	Photographing Parts					
<b>10</b>	<b>LECTURE 10</b>	1-Jun	W	12:30 PM	550-200	
	End of Class Details Announcement					
	Special Guest Speaker					
	<b>WORKSHOP 10</b>	3-Jun	F	11:30 AM	Lathrop 299	
	Presentation Coaching					
	Questions, extra help					
<b>11</b>	<b>LECTURE 11</b>	8-Jun	W	12:30 PM	TBD	Final Project Due
	Student Presentations					