

University of New Hampshire

Introduction to 3D Printing

ET 401 - Fall 2019

Objectives: This project-based course introduces current methods in the design and fabrication of 3D models. Students will apply and integrate techniques from mathematics, engineering, and computing to design 3D models and then manufacture them by the use of 3D printers. As this course fulfills the environment, technology, and society (ETS) requirement in the discovery program, an emphasis will be placed on the ways in which 3D printing effects both the environment and our collective society.

Learning Outcomes: After completion of this course students will be able to:

- Identify and define basic terms in manufacturing
- Compare and contrast multiple manufacturing techniques impact on the environment
- Identify areas in society likely to be impacted by new additive manufacturing techniques
- Assess the effectiveness of current advances in 3D printing technologies
- Model complex geometric shapes using various computer software applications
- Revise and improve upon their own as well as other's existing models
- Publish their work under a creative commons license as an open resource for society

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Office Hours (Room 137): T/R 9:00 am -10:00 am, and directly after class. Additionally, if those office hours don't work for your schedule, you can always make an appointment to meet with me at another time. Please note that an appointment is not necessary to come to office hours during the above listed times.

Prerequisite: None.

Grading: Your final grade will be computed as follows:

- Participation: 10%
- Discussion Board 10%
- Online Portfolio: 60%
- Final Project: 20%

Grades are determined only by the points earned from the assignments listed above that are given during the semester. There is no opportunity other than what is explicitly stated in this syllabus to earn extra points, that is, no special assignments nor additional work beyond that given to other students.

Participation: It should be obvious, but one cannot participate in class if one is absent; hence, attendance is mandatory, as is being punctual. I make no pretense that evaluating the class participation portion of your grade is objective - it is subjective and takes many things into account, such as being engaged while in class. I have found that a student's attitude drives so many important factors having to do with class participation (or lack thereof); e.g., do they come to class late (and if so, how often), do they have un-excused absences (and if so, how many), does their cell phone ring during class (or even worse, do they read or send text messages during class). Note that with the exception of missing class (which, as stated above is mandatory), all of these examples can have a disruptive effect in the classroom. In the event of inclement weather on the day of class, please try to allow enough time to get to class on time and find a parking spot. That said, we can all get surprised by a bigger than expected snowfall and/or the roads are slower going than we would have thought; if this happens, please slow down and drive safely - your class participation grade will not be lowered for being late on such a day. I implemented this class participation policy not to be punitive, but rather, to be a reward to show you how much I value you coming to class (and, of course, you should, too). Think about it, **everyone has an A for 10% of their grade, right now, at the start of the semester.** Put another way and this is what it's really all about - coming to class on time, turning off your cell phone, not being disruptive, et cetera, is about showing respect for yourself, your peers, and me.

Online Portfolio: In this class you will document each of your projects by making an online design portfolio showing off your work . The portfolio will give a visual and textual representation of your progression through each project. The design portfolio is to act as a resource for others to be able to learn from your work, and as such, its goal is to document the design process with enough detail so that others in society are easily able to recreate your designs. For this reason your portfolio will be published under a creative commons license at 3dprinting.illustratingmath.com. More details about the requirements of this portfolio will be discussed in class.

Discussion Board: Each project during the semester will begin with an in-class discussion on the environmental and societal impacts of the 3D printing techniques and technologies featured in that project. You will then be required to participate in a weekly online discussion board where you will be tasked with exploring further impacts of 3D printing on the environment and society through its use in various disciplines. For each post you will be required to identify at least one environmental and one societal impact for the topic under discussion. You will also be required to post a meaningful reply to another classmates initial post, where you compare or contrast these impacts by providing additional examples.

Final Project Your final project in the class is to create and document a design of your choosing using all of the techniques that we have learned throughout the semester. The design that you choose however must make an original contribution to either engineering, art, or mathematics, and must also be approved by your instructor prior to implementation. Your final design will be graded based on the following criteria: Aesthetic appeal, functionality, durability, and complexity.

Grades are assigned as follows:

A starts at 92.5	C starts at 72.5
A- starts at 89.5	C- starts at 69.5
B+ starts at 86.5	D+ starts at 66.5
B starts at 82.5	D starts at 62.5
B- starts at 79.5	D- starts at 59.5
C+ starts at 76.5	F below 59.5

Students with Disabilities: The University is committed to providing students with documented disabilities equal access to all university programs and facilities. If you think you have a disability requiring accommodations, you must register with the Disability Services Office. The Disability Services Coordinator at UNHM is Jenessa Zurek. Jenessa can be contacted at (603) 641-4170, jenessa.zurek@unh.edu or in person in the Student Services Suite, Room (#410H). Please be aware that I cannot make any accommodations prior to you meeting with disability services.

Some Project Descriptions

Penny Trap: This project will guide you through the process of creating a penny trap. This unique design can only be constructed by the use of a FDM 3D printer as it traps the penny inside of it one layer at a time. This project will help to illustrate the differences between traditional manufacturing techniques and what is possible with the advent of the 3D printer.

Sign: For this project you push the limits of what is currently possible to print at home with a desktop 3D printer. Designing an object that can be printed in two colors involves splitting your model into two interlocking pieces that fit together like a puzzle. You will use this design idea to create a sign of your choosing that benefits from the addition of using two colors in the printing process.

Reproduce an important building: 3D printing allows us to make reproductions of many things in the world around us. In this project you will choose an aesthetically interesting building to make a scale model from. Points will be awarded for overall accuracy and attention to detail.

Metallic Pendant: Not only can 3D printing create objects out of different types of plastic but it may also be used to directly print things made entirely of metal. In this project you will design a mathematical pendant that uses either polar coordinates or the theory of knots and links for its construction. You will design the pendant to the specifications required so that it may be printed out of metal. If you would like to pay for the metallic version of your pendant we will send the files to be professionally printed through an online service.

Action Figure: The hinge is a key component in being able to construct mechanical machines that consist of multiple moving parts. Engineers design compound machines to make tasks easier and to benefit society. This lesson encourages you to think about past machine inventions and their usefulness in our lives. For this project you are to design and test a working hinge or lever.

Functional Print: This project helps to illustrate the usefulness of being able to modify and design the environment around you with the use of a 3D printer. You are to use the skills that you have developed to fix or improve upon something from your home. Bonus points will be awarded if the design fix improves upon a feature or functionality of the original piece. For inspiration we will read through <https://www.reddit.com/r/functionalprint/>.

Make a Manipulative: Do you remember a professor using a prop to help illustrate an idea in a recent class? This project will have you model and 3D print your own version of this prop. To find a design each student will interview a professor to discover what manipulatives or props are used in their classroom. After the project is completed you will present the newly designed model to the professor that was interviewed for the idea.