

APPL418
3D Printing Technology and Practice
Exploration of Additive Manufacturing
Summer 2021

1.0 Cr.

<p>Introduction</p> 	<p>3D Printing, or additive manufacturing (AM), is widely used in a broad range of fields from manufacturing to medical research. AM is generally expected to play an increasingly large role in virtually all areas of research, industry, and commerce with new technologies and significant improvements occurring on a continuous basis. In this course, we will delve deeply into each of the major existing and developing technologies. We will explore the elements of design for AM, motion control and imaging technologies, materials performance and selection, and the physics of parts production.</p>
<p>Methods</p>	<p>Class/lab time will consist of synchronous coverage of principles and hands-on activities using various 3D printing hardware and software. Work outside of class will consist of additional exercises that extend and build upon in-class material. Mastery of concepts will be demonstrated by successful optimization and production of a variety of 3D-printed components.</p> <p>We will use various additive manufacturing technologies in the BeAM makerspaces for both in-class exercises as well as homework assignments/projects. This course also plans to incorporate fieldtrips to various additive production facilities on UNC campus as well as other locations in the RTP vicinity.</p>
<p>Results</p>	<p>In brief our objectives are to:</p> <ul style="list-style-type: none"> • Develop a solid foundational understanding of the basic principles of additive manufacturing including detailed knowledge and understanding of the primary AM technologies, AM materials, and their applications • Apply gained understanding to selection of technology and material in order to achieve desired part performance characteristics and • Promote application of knowledge and experience to real-world needs and problems <p>On completion of this course of study, you should be able to:</p> <ul style="list-style-type: none"> • Explain and demonstrate operation of primary AM technologies • Apply understanding of AM technology and materials to the design and fabrication of an engineered part. • Design a specified part for optimum AM fabrication • Evaluate AM materials properties in order to select appropriate materials for a specific design. • Identify and demonstrate function of basic motion control systems through hands-on interaction with AM equipment.

Course Content

➤ COURSE TOPICS

- Review of current technologies
- Developing technologies
- Polymer science – fused filament
- Polymer science – SLA
- Polymer science – SLS
- Print setting optimization
- Design considerations
- Motion control
- Slicing software
- Post processing

➤ COURSE SCHEDULE

The current course calendar is available in Sakai under Resources

Class Essentials

➤ CONTACT INFORMATION

Dr. Glenn W. Walters



-  **Office Location**
158 Caudill Labs (in the Caudill Knuckle)
-  **Email**
walters@unc.edu
-  **Phone/Text**
(919) 451-1750

➤ LOGISTICS

 **Class meeting times**
10:00 – 12:00 MTWTHF
June 10 – 21, 2021

 **Class meeting location**
Venable G311
off of the ground floor lobby

 **Office Hours**
Thursdays 2:30 – 4:30
or by appointment

Required Texts

Redwood, Ben, Filemon Schoffer, and Brian Garret. ***The 3D Printing Handbook: Technologies, Design, and Applications.*** Amsterdam: 3D Hubs, B.V., 2018.

Software

Tinkercad – create your free account at <https://www.tinkercad.com/>

Autodesk Fusion 360 – Create a free educational account available at the [Fusion 360 students and educators page](#).

[Cura Slicer software for Ultimaker printers](#)

[Cura Slicer software for Lulzbot printers](#)

[Preform Slicer software for Formlabs printers](#)

Assignments & Evaluation

➤ YOUR COURSE GRADE

50% Attendance	This course is fully participatory and attendance is required at all sessions
20% Classroom Exercises	Print design, processing, and printing during instruction
30% Individual Projects	Individual exercises completed outside of class

➤ GRADE INTERPRETATION & HONOR CODE

Your final course grade will be determined as follows: Pass ≥ 60% Fail < 60%	ACADEMIC HONESTY There will be clear communication if assignments are individual or group. For individual assignments, while I encourage collaboration, it is a violation of the honor code if a student duplicates work or obtains solutions from another student and submits it as their own. Please reference the honor code: http://honor.unc.edu .
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➤ STUDENT RESOURCES

SEE, SAY, DO SOMETHING We're happy you are here and eager to learn. Despite our best intentions to follow a plan, life may throw us a curve ball. If you or someone you know is experiencing some distress or you are concerned about the well-being of a student, please report it here: https://deanofstudents.unc.edu/carereport . It is important to support one another. If you see something, say, and do something.	ACCESSIBILITY RESOURCES UNC-CH provides accommodations for any students with documented disabilities. If you have a disability and believe you require accommodations, please contact the Department of Accessibility Resources at http://accessibility.unc.edu . Please contact me early in the semester so we can make any necessary arrangements and discuss the learning checks.
TITLE IX Resources <i>Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Please contact the Director of Title IX Compliance (Adrienne Allison – Adrienne.allison@unc.edu), Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu), Counseling and Psychological Services (confidential), or the Gender Violence Services Coordinators (gvsc@unc.edu; confidential) to discuss your specific needs. Additional resources are available at safe.unc.edu.</i>	

➤ COURSE EXPECTATIONS AND POLICIES

<ul style="list-style-type: none"> • Community Standards in Our Course and Mask Use. This fall semester, while we are in the midst of a global pandemic, all enrolled students are required to wear a mask covering your mouth and nose at all times in our classroom. This requirement is to protect our

educational community — your classmates and me — as we learn together. If you choose not to wear a mask, or wear it improperly, I will ask you to leave immediately, and I will submit a report to the [Office of Student Conduct](#). At that point you will be disenrolled from this course for the protection of our educational community. An exemption to the mask wearing community standard will not typically be considered to be a reasonable accommodation. Individuals with a disability or health condition that prevents them from safely wearing a face mask must seek alternative accommodations through the [Accessibility Resources and Service](#). For additional information, see [Carolina Together](#).

- This course is highly interactive and attendance at all sessions is required unless previously arranged with the instructor. Attendance is regularly recorded and is a factor in your final grade.
- In the event of an unavoidable absence (e.g. medical), a written explanation is required. I expect all students to abide by the [UNC Class Attendance Policy](#).
- During class time, do not use your phone or computer for something unrelated to class; research shows that this is distracting to other students in the class. If there is an urgent situation, then you can leave the classroom to use your phone or computer. Unless specifically instructed otherwise, **all electronic devices should be packed away during class.**
- You will be working closely with your classmates and should accord them all of the respect and honor that you yourself expect in return. Our goal is to overcome inhibitions to creativity so it is very important to give and receive critique in an objective and professional manner. There are no bad ideas in this class, just a whole lot of ideas that are part of the pathway to a solution. Remember that the crazy, stupid, and impossible ideas have often been the early steppingstones to world-changing innovation.
- Due dates are given with each assignment. It is expected that assignments be submitted at the beginning of class, on the due date.
- This is a course in engineering fundamentals. As such, there is a need to acquire definitive and quantitative knowledge. Homework assignments allow you to develop and hone the necessary quantitative skill sets and are graded based on problem solving process, format, and content. For project and lab assignments, I primarily use a system known as specifications grading which focuses more on successful completion of assignments rather than quantitative ranking of your work relative to some ideal standard. In this system, I expect you to meet the specifications provided in the rubric to receive points for the assignment. For most such assignments, individual specifications will be assigned point values and points will be awarded on the basis of whether or not each specification is met.
- I also require evidence and documentation of your problem-solving process. For homework problems, we will use the Engineering Homework Format (see handout). For design exercises, we will use an engineering portfolio documentation process which can include sketches, narrative journaling, design files, and photographs. Demonstrated artistic and engineering skills are not primary factors in project evaluation. This does not, however, relieve the student from the obligation to produce neat, well thought-out work.

I reserve to right to make changes to the syllabus, including project due dates and test dates (excluding the officially scheduled final examination), when unforeseen circumstances occur. These changes will be announced as early as possible so that students can adjust their schedules.