APPL590
Design and Making for the Researcher
Spring 2022

Introduction	Design thinking is a popular buzz term in this age of Kickstarter, instant turnaround, and short time-to-market. But what is design thinking really all about? In many ways, it is a process that most of us were quite familiar with in our preschool years. Observe an opportunity. Take an action. Assess the results. Laugh at the failures. Repeat.
	In this graduate-level course, we will parallel the discovery process taught in APPL110 - learning about human-centered design, needs identification, and the iterative design and prototyping process. In addition, we will provide practical overviews on several technical areas common to many research laboratories such as hardware selection, gas and liquid management, material compatibilities, electronics and data acquisition, etc. In addition to the BeAM makerspace focused skills development activities conducted in APPL110, students will work on a personal project related to their work in the laboratory or research topic.
Methods	Instructional time will center around team exercises in ideation, brainstorming, and creation of physical prototypes. Concepts and process in design will be presented and discussed throughout class sessions with concurrent mentored activities that illustrate the discussion material. In simple terms, we'll talk about the important elements of design and prototype development and, at the same time, you'll be doing and making things that will illustrate what we're talking about.
	A typical class session will start with a brief synthesis of the previous sessions and project work. We will then introduce the concept or expansion for the current session. We will frequently work in groups through a guided design activity that incorporates creation of physical objects. These exercises will be actively facilitated by the instructor and TA mentors and feedback will be provided throughout the class period. In many cases, the classroom activity will extend into a homework assignment that will be completed by the team prior to the next class meeting.
	Students will need to meet in teams outside of class time in order to complete assignments. For certain assignments, the teams will have access to mentors and the instructor during their team meetings.
	Our students are expected to make extensive use of the BeAM makerspace network. BeAM is the perfect environment to continue your growth as an ideator and to make connections with fellow makers. BeAM is a safe zone for skills development, self-expression, and productive failure!

Results	In brief our objectives are to: • Develop basic functional familiarity with general technical areas in the research environment. • Develop physical prototyping skills using a variety of media • Develop and reinforce positive and productive means of actively using failure to improve your creative process. • Develop design critiquing skills in the group environment • Develop an open-mind approach to brainstorming • Develop skills necessary to rapidly create physical representations of ideas. On completion of this course of study, you should be able to: • Efficiently demonstrate a design concept through physical manifestation (e.g. drawing, paper modeling, cardboard fabrication, 3D printing, etc.) • Clearly explain and provide examples of the basic tenets of human-centered design • Develop and clearly explain your personal design process • Demonstrate the ability to efficiently explain a design concept to team members in a manner that allows the team to effectively bring the idea to life • Objectively critique personal failures and make recommendations for improvement in those areas • Identify team member strengths and demonstrate ways to employ and empower those skills
Discussion	Our goal in this course is to empower you to bring ideas to reality. Learning and practicing technical skills are important elements of this process. You will apply your developing understanding of technical details to the design and creation of artifacts that address research needs.
Engineering Student Outcomes	On completion of this course of study, you should be able to: ○ ABET Demonstrate the ability to communicate effectively with a range of audiences. ○ ABET Demonstrate the ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. ○ ABET Demonstrate the ability to acquire and apply new knowledge as needed, using appropriate learning strategies. KEEN Demonstrate constant curiosity about our changing world. KEEN Explore a contrarian view of accepted solutions. KEEN Integrate information from many sources to gain insight. KEEN Identify unexpected opportunities to create extraordinary value. KEEN Persist through and learn from failure. KEEN Identify personal passions and a plan for professional development. KEEN Fulfill commitments in a timely manner.

Class Essentials

➢ CONTACT INFORMATION

Lead Instructor **Dr. Glenn Walters**		**Teaching assistants**
🏢 **Office Location:** 158 Caudill ✉ **Email:** walters@unc.edu 📞 **Cell:** (919) 451-1750 📅 **Office Hours:** TTH 3:30 – 5:00		**TBD**

➢ LOGISTICS

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TTH 12:30 – 1:45 PM

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G010 Genome Sciences Building, and remotely on Zoom

Target audience: Graduate students that are working in any research area where creation of physical devices or artifacts will facilitate or improve the conduct of their research.

Pre-requisites: none

Required Texts:

- Wodtke, Christina. *Pencil Me In: The Business Drawing Book for People Who Can't Draw*. Christina Wodtke, 2017. *Available now(?) at Student Stores*
- IDEO. *The Field Guide to Human-Centered Design*. IDEO.org, 2015. *Available on the class Sakai site under Resources or at https://www.designkit.org/resources/1*
- Doorley, Scott, Sarah Holcomb, Perry Klebahn, Kathryn Segovia, and Jeremy Utley. *Design Thinking Bootleg*. Berkeley: Hasso Plattner Institute of Design at Stanford, 2018. *Available on the class Sakai site under Resources or at https://dschool.stanford.edu/resources/design-thinking-bootleg*

Additional readings will also be assigned during the semester.

Software

- *Adobe Illustrator/Adobe Creative Cloud* – available at no cost to UNC students at https://software.sites.unc.edu/software/adobe-creative-cloud/
- *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.

Course Content

➢ COURSE TOPICS

- Human-Centered Design Concepts and Methods
- Design Critique and Iteration
- Entrepreneurial Mindset in the Design Environment
- 2D Design Process and Considerations
- Measurement and Dimensioning
- Laser Cutter Physics and Principles
- Laser Cutter Workflow and Methods
- 3D Design Process and Considerations
- Solids Modeling Fundamentals with TinkerCad and Fusion 360
- Fundamentals of 3D Printing
- Design for 3D Printing
- Vinyl Cutter Principles and Applications
- Adhesives – Fundamentals and Applications
- Mechanical Fasteners – Fundamentals and Applications
- Fluid Fittings – Fundamentals and Applications
- Basic Electronics – Simple Circuits
- Basic Electronics – Arduino Microcontroller Environment
- Repurposing, Hacking, and Reverse Engineering

➢ COURSE SCHEDULE

The current detailed course calendar is available in Sakai under Resources

To help you succeed

➢ OFFICE HOUR SCHEDULE

Each member of the teaching team is available during regular office hours.   Unless otherwise specified, these are hours that we will be available via Zoom. These hours are subject to change but are currently scheduled as follows:

Monday	Tuesday	Wednesday	Thursday	Friday
TBD				

➢ COURSE EXPECTATIONS AND POLICIES

- 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;
- 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.
- In this class, 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 simpler assignments, this will be all or nothing. For more detailed 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 process which can include sketches, narrative, 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.

➢ 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.

CAPS is strongly committed to addressing the mental health needs of a diverse student body through timely access to consultation and connection to clinically appropriate services, whether for short or long-term needs. Go to their website: https://caps.unc.edu/ or visit their facilities on the third floor of the Campus Health Services building for a walk-in evaluation to learn more. *(source: Student Safety and Wellness Proposal for EPC, Sep 2018)*

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
The University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in barriers to fully accessing University courses, programs and activities.
Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the ARS Website for contact information: https://ars.unc.edu or email ars@unc.edu.

Title IX Resources	**Community Standards in Our Course and Mask Use**.
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.	This 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.

Assignments & Evaluation

➢ YOUR COURSE GRADE	
35% Individual Projects	Structured individual fabrication assignments – technical skills development
25% Group Projects	Group design and fabrication assignments – process skills development
40% Individual Final Project	Comprehensive individual design and fabrication project
100% Total	

➢ MAJOR COURSE DUE DATES	
Final Project	TBD
Final Exam Period	Tuesday May 11, 2022 12:00 – 3:00 PM

➢ GRADE INTERPRETATION & HONOR CODE

Your final course grade will be determined from a standard scale	ACADEMIC HONESTY
GRADUATE	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 on their own. Please reference the honor code: http://honor.unc.edu.
H 90.0+	
P 70.0 - 89.9	
L 60 - 69.9	
F <60	
UNDERGRADUATE	
A 94+	
A- 90.0 - 93.9	
B+ 87.0 - 89.9	
B 84.0 - 86.9	
B- 80.0 - 83.9	
C+ 77 - 79.9	
C 74 - 76.9	
C- 70 - 73.9	
D+ 67 - 69.9	
D 60 - 66.9	
F <60	

➢ CLASS RECORDING POLICIES

The University may record meetings of this class for educational purposes. These recordings will be shared only with students enrolled in the course for purposes of academic instruction. Your instructor will communicate to you how you may access any available recordings. Unauthorized student recording of classes on personal devices or on any other format is prohibited.

Students requesting the use of assistive technology as an accommodation should contact Accessibility Resources & Service. Other students must obtain express permission from the department to record the class, and the University will only grant such permission in extraordinary circumstances in which the student otherwise lacks access to a recording made by the University or instructor. Students shall not copy, reproduce, or distribute any recordings of their classes, and students shall delete any recordings at the conclusion of the course.

Any violation of these prohibitions or restriction on the making, use, copying, or distribution of recording of classes shall constitute an honor code violation.

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.