

ME 4853 / ID 4050 / MGMT 4853 Syllabus

Product Design and Realization

Lecture: MW 9:30 - 10:20AM, MRDC 2101

Lab: F 12:30 - 3:15PM, MRDC 2101

Instructor Information

Instructor

Prof. Wayne K. Li

Email

wayne.li@design.gatech.edu

Drop-in Office Hours & Location

By Appt, Design West 254

Teaching Assistant(s)

Taylor Allen

Email

tallen89@gatech.edu

Drop-in Hours & Location

12-2pm Mondays; REAR Lab or Zoom

General Information

Description

In this course, students learn the fundamentals of product realization for transforming a concept into a fully functioning product. The course includes a hands-on engineering design project in which students refine a design concept via virtual and physical prototyping in the context of human-centered design. Prototyping includes early-stage prototypes for testing fit, form, and function, along with fully functional prototypes that are representative of the final product. Students gain significant experience with additive manufacturing and other low-volume fabrication techniques, as well as designing and planning for high volume production. Prototyping is accompanied by digital engineering to support generative and simulation-based design, experimentation, intelligent systems, and digital twins. The curriculum emphasizes product realization in the context of human-centered design, including human-product interactions, ergonomics and anthropometry, and ethnographic techniques for empathizing with and more deeply understanding the human users of technology.

Pre- &/or Co-Requisites

ME 2110 (for ME students), ID 2325 (for ID students), similar sophomore-level course for other majors

Course Goals and Learning Outcomes

Upon completion of this course, each student should be able to:

- Transition a design concept towards production efficiently and effectively, supported by well-informed, well-justified decisions and strategic planning;
- Evaluate and make well-informed, well-justified decisions regarding the complementary roles of prototyping, simulation, and human-centered design in product realization.
- Implement human-centered design techniques to guide the embodiment of products/systems, including considerations of human-product interaction, ergonomics and anthropometry, aesthetics, and interviewing techniques focused on prototyping;
- Design and build prototypes with design for manufacturing considerations, where manufacturing includes additive manufacturing, low volume manufacturing (machining, water-jetting, wood working), and production manufacturing (molding, forming, casting); Transition the design of a low-volume prototype into a design for high-volume production;
- Critically evaluate multiple options for prototyping and make well-informed, well-justified decisions regarding the best combination of options for a specific project;
- Create and interrogate simulation models to evaluate and refine potential designs and to serve as digital twins of a physical part/system; and
- Utilize data mining, machine learning, and generative design to support and accelerate the design process.

Course Requirements & Grading

Description of Graded Components

Semester-Long Project		55%
Critique of Group Project	5%	
Project Proposal	5%	
Milestone Deliverables (3 x 5%/milestone)	15%	
Final Project Report	20%	
Final Project Exhibition	10%	
Mini-projects		35%
Individual mini-projects (3 x 10%/project)	30%	
End-of-semester reflection	5%	
Attendance, participation, peer evaluations		10%
Total		100%

Project. Students will form groups of 4-6 and apply topics learned in the course to an in-depth product design/realization project that involves significant prototyping and modeling. More details on project topics and options will be provided by the instructor. Projects are evaluated based on a critique of a group project, a project proposal, milestones, a final project report, and a final project exhibition.

Assignments. Three mini-projects will be assigned. Details will be provided in class. All assignments should be submitted via Canvas.

Attendance, Participation, Peer Evaluations. Attendance in class is critical for success in the course and monitored with periodic roll calls and Canvas statistics. The instructor also monitors your participation in class activities and considers this assessment in your final grade, along with the results of peer evaluations of your participation in team project activities. Class presence and participation points are given to encourage your active participation in class and group projects. You will be rewarded with a perfect score as long as you frequently come to class, actively contribute to the class discussion during lectures, and make strong contributions to your project team. The instructor will consider the results of peer evaluations of your participation in team project activities as part of this grade. If injury, illness, or other extenuating circumstances require you to be absent from class for multiple days, please notify the instructor as soon as possible.

Deadlines and Penalties. Assignments are due on Canvas before the beginning of class on the designated day. Project proposals and reports are due on Canvas at the time indicated on the course schedule. Unless prior approval is obtained from the instructor, late submissions will be penalized 10% or one letter grade per day. If you need special accommodation from the instructor for an approved Institute activity (e.g., an athletic event), a religious holiday, or a personal or medical emergency, please contact the instructor as soon as possible and preferably in advance of the due date.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Course Materials

All course materials are available via Canvas. No textbook is required for the course.

Course Expectations & Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible to set up a time to discuss your learning needs.

Collaboration & Group Work

You are encouraged to discuss any assignments and projects with classmates and project team members, but do not plagiarize the work of others by copying from the web, other students, previous students, articles, or other sources (aside from compiling work from your teammates for group project activities) without properly referencing your sources.

Use of AI: Computer Algorithm Generated Work

You are encouraged to be inspired and use AI tools for your projects. In essence, this is a class to better describe how to access these tools and incorporate them into work. However, there is also a catch with the use of AI. Legally, many AI tools do not assign you the intellectual property rights for usage of their algorithm. For the sake of the course, this isn't an issue, but be aware that in professional practice, this would hamper your ability to market your design. For the purposes of this class, when your team utilizes this technology, for inspiration or for presentation, please be sure to indicate where AI was used, and if it is the result of a specific AI generator. It is required that your design work still be your own / team generated. Thus, even if handing in a final with AI generated work, you would be required to also document the original design that was fed into the generator. For inspiration work, your original final work must show a departure from the AI inspiration (e.g., it can not be just a copy/trace of AI work).

Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Student Use of Mobile Devices in the Classroom

As research on learning shows, unexpected noises and movement automatically divert and capture people's attention, which means you are affecting everyone's learning experience if your cell phone, pager, laptop, etc. makes noise or is visually distracting during class. That said, many students find it useful to have a mobile device on hand to access course materials. With this in mind, you may take

notes on your laptop or tablet during class, but please turn off the sound so that you do not disrupt other students' learning. In addition, please silence your cell phone and place it in your pocket or backpack during class.

Inclusive Classroom

Professional courtesy and sensitivity are especially important with respect to differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationality. In this class, we will strive to create a culture of respect and appreciation for our individual differences. Prof. Li will gladly honor your request to address you by a name that is different from what appears on the official roster, and by the gender pronouns you prefer. Please advise her of any changes early in the semester, so that she can update her records.

Communicating with the Instructor

Questions and discussions are always welcome. Aside from office hours by appointment, the best way to reach the instructor or TA is via email, which they check frequently and strive to answer as quickly as possible.

Course Topics

Introduction to the Course and Overview of Product Design and Realization Process (1 lecture)

Human Centered Design (5 lectures)

Human-product interaction, aesthetics and industrial design, anthropometry, and ergonomics

Hands-on Prototyping and Manufacturing (7 lectures)

Design for additive manufacturing, low volume manufacturing (machining, water-jetting, wood working), and production manufacturing (molding, forming, casting), including case examples in mass manufacturing

Digital engineering for product realization (6 lectures)

Generative design, simulation-based design, statistical experimentation and robust design, data mining, digital twins, and intelligent product systems

Evaluation of the complementary roles of prototyping, simulation, and human-centered design in product realization (Throughout)

Student presentations and guest speakers (7 lectures)

Acknowledgements

This course is the first offering/foundation of the TechMade Initiative; a joint collaboration between the Schools of Mechanical Engineering, Industrial Design and Management within their respective units. Techmade seeks to bridge engineering, design and management more holistically and invites participation with other majors at the Institute.

Materials for this course have been developed by a many, but special thanks goes to a triumvirate of faculty for input and the hard efforts of putting the slides together. Those faculty are Dr. Carolyn Seepersad (ME), Prof. Amit Jariwala (ME), Prof. Wayne Li (ID/ME) and a special thanks to Prof. Karthik Ramachandran (MGT). Without your input, the TechMade program would not have the direction it seeks to give. Many thanks.