

Des 326 – Digital Fabrication

Spring '21

University of Washington

(5 credits)

Time / Location:

Tues / Thur. 12:30-3:20pm, ONLINE (Zoom, Canvas, other)

Instructor:

Jason O. Germany, Associate Professor - ID

jgermany@uw.edu

Art Rm 134

Office hours: "by appointment" (Zoom meetings)

Overview / Objectives:

This course will cover topics pertaining to the use of digital tools as they relate to modern industrial design methods. Digital tools (2D raster – vector / CAD / CNC / Rapid prototyping / Laser cutting) provide one more avenue for product designers to ideate, evaluate, and communicate their ideas. In the course of design and development these pieces of software as well as prototyping machines add a level of accuracy and refinement that can have the ability to take rough concepts to final working pieces. This course is meant to bridge the gap between hand generated methods and the virtual world of CAD modeling and digital fabrication. It should be noted that this course will cover a significant amount of software ranging from 2D to 3D systems and will function as intensive overview. Although this course may not directly utilize all forms of digital prototyping during the various course projects, there will be several discussions related to digital fabrication methods as they pertain to larger topic of product design and visualization.

Structure:

The class will meet online via Zoom and other software platforms. Online setting will provide the class with an opportunity to learn and explore the uses and applications of several different software packages. Physical prototyping by students in Art Building spaces is currently prohibited and there is not anticipated lab access for the duration of the spring 2021 quarter. Video demos and other physical prototyping will be relayed online by the instructor and instructional tech. periodically during the quarter. In general, the class time will be split between instruction and action so students should be prepared to learn as well as create during each meeting.

Graded course work:

Grades are based on the quality of work, the ability to meet deadlines, your process throughout all aspects of the assigned projects, and in-class participation in exercises, discussions, and critiques as facilitated online or in a flipped class format. The deliverables for this course will be composed of projects that incorporate 2D / 3D modeling and digital prototyping (more details on this later) as well as the iterative design steps in-between (sketching, etc.). The grading / course projects / homework will be as follows (additional project details will be provided):

Project #1 – Warm up 2D project = 15%

Project #2 – 3D CAD + 3D print project = 25%

Project #3 – 3D lofting + CNC project = 25%

Project #4 – 3D surfacing + Final Project = 25%

Activities and participation = 10%

Homework / projects and late turn-in policy:

Deadlines are an important part of the design process so please be present on the day that material is due and deliver what you have completed. Homework is due on the assignment date at the beginning of the course meeting time. I will accept late homework assignment deliverables for up to 48hrs. after the initial due date / time but deliverables turned in during the first 24hr time period (late day 1) will be graded 25% off and deliverables turned in during the following 24hr time period (late day 2) will be graded 50% off. I do not accept late homework submitted more than 2 days (48hrs) after the initial due date / time. With that in mind, if you are not able to attend class on the day that homework is due because of illness, emergency, academic related absence, or disability then submit online, email me OR contact me via email before the end of the deadline time (class date / meeting time). Additionally, many of the deliverables in this course will be digital uploads to Canvas – please keep in mind that the cut off for the deadlines still applies.

Participation:

As this is a studio based course, attendance to each (Zoom) meeting of the prescribed course times will be critical for advancing your own work and coordinated work with other students. Much of the material required to fully participate in this course will be presented and discussed during scheduled class time and feed directly into assignments. Additionally, various activities (critiques, reviews, presentations, demos, exercises, guest speakers, etc.) will only take place during course scheduled times and it is your participation in the overall course exercises and tutorials will allow for the best educational atmosphere.

Individual Assignments:

Individual assignment handouts will be distributed separately from this syllabus. These handouts will have specific deliverables and dates for each phase of the project and should be used to determine the individual details of each assignment. These will be posted as a .pdf on canvas under assignments.

Communication:**- Student to Instructor**

Aside from in-class course meeting times via Zoom, I am accessible during my office hours by appointment (scheduled via Zoom). Additionally, I can be reached by email. There is often limited time before and directly after the scheduled course times so please take advantage of these other methods of contact. When utilizing email as a form of communications, allow 1 school day for response during regular business hours – don't expect this form of communication (email) to be affective during evenings, weekends, or holidays.

- Instructor to Students

The three primary methods of communication during the term are in-class meeting times (Zoom), online via Canvas and email. Make sure to check for online announcements as well as posted course materials each week as Canvas will be the central depository for much of the assignments, additional readings, etc. Periodically, I will send out emails with additional announcements related to the course and homework assignments. It is the responsibility of the student to check their *University of Washington email* in a regular manner so as to stay informed to changes in scheduling or assignments.

Evaluation scale:

Evaluation and distribution of grades will be as follows:

A 3.8–4.0 is given to a student who has exhibited the highest possible performance in all aspects of the course—final projects, the design process and participation are excellent. This student independently seeks out additional information on design and is highly committed/passionate about their work.

A 3.4–3.7 is given to a student who exhibits superior performance in all aspects of the course—the final projects, design process, and participation are uniformly of high quality. This student has a thorough understanding of all concepts presented, and is motivated to improve and succeed.

A 2.9–3.3 is given to a student who has good performance in most aspects of the course. This student follows a thorough design process, has good design work, and consistent participation that reflects a clear understanding of almost all concepts being presented.

A 2.5–2.8 is given to a student who has fair performance in the course. The final work is adequate, with a design process that reflects the minimum needed to complete assignments. Participation and motivation are moderate.

A 0.0–2.4 is given to a student with poor performance in the course. Projects are incorrectly prepared, incomplete or missing. This student does not understand the majority of concepts presented and rarely participates in class. This student is not prepared for subsequent courses in design.

Text / Reading:

All reading or text related to this course will be provided in electronic or print form by the instructor

Recommended Tools:

1. Caliper (6in, digital, SAE / Metric readout), \$15-22

- Affordable options (Neiko, SE, Pittsburgh)

http://www.amazon.com/Neiko-Stainless-Digital-Caliper-Extra-Large/dp/B000GSLKIW/ref=sr_1_1?s=industrial&ie=UTF8&qid=1313112085&sr=1-1

http://www.amazon.com/Caliper-Electronic-Stainless-Steel-Body/dp/B0019O6OCO/ref=sr_1_4?s=industrial&ie=UTF8&qid=1313112085&sr=1-4

<http://www.homedepot.com/p/Husky-6-in-3-Mode-Digital-Fractional-Caliper-1467H/206007130>

- Home Depot on Aurora will also have 6 in digital calipers

2. Calculator (basic type, no special functions required, cell phone is fine)

3. File storage = USB flash drive OR save to cloud storage (1GB minimum, 4GB recommended)

* Note: Always backup your files from this USB flash drive or online storage system as they are often corrupted or are lost.

Resources (not required):

Online Tutorials: SolidProfessor

There are various online tutorial videos and programs, one such tutorial service is called SolidProfessor. This services allows for a 1 year membership and can be used to support SolidWorks as well as other CAD and CAM related software.

<https://www.solidprofessor.com/>

Software –

SolidWorks Student Design Kit – 1 year free download

- See canvas pages for details, code and windows download requirement

SolidWorks Remote Desktop – free for students (Art Rm 215 lab)

- See canvas pages for details, code and windows download requirement

SolidWorks Student License (1yr) for purchase - \$99.99

<https://www.solidworks.com/product/students>

SolidWorks online tutorials (separate from SolidProfessor)

- In SolidWorks software > go to Help > choose SolidWorks tutorials

https://www.solidworks.com/sw/support/54117_ENU_HTML.htm?product=SOLIDWORKS%20CAD
<http://www.solidworkstutorials.com/>
<http://www.youtube.com/> (search for solidworks and your issue)

KeyShot demo –free but no saves
<https://www.keyshot.com/try/>

KeyShot Educational License (1yr) - \$95.00
<https://buy.keyshot.com/collections/keyshot-education>

KeyShot online tutorials, webinars, forum, free .hdz file downloads
<https://www.keyshot.com/resources/learning/tutorials/>
<https://www.keyshot.com/resources/downloads/>
<https://www.keyshot.com/resources/learning/webinars/>
<https://forum.keyshot.com/>

Rhino CAD (90 day free trial)
<https://www.rhino3d.com/download>

Rhino CAM (free demo – no saves)
<http://www.mecsoft.com/DownloadRhinoCAM.shtml>

Material suppliers -

UW Bookstore
<http://www.bookstore.washington.edu/home/home.taf?>
206-634-3400

Hardwick & Sons, Inc.
<http://www.ehardwicks.com/>
206-632-1203

University True Value
<http://ww3.truevalue.com/universitytruevalue/Home.aspx>
206-523-5353

Tap Plastics
<https://tapplastics.com/>
206-389-5900

Laird Plastics
<https://www.lairdplastics.com/>
206-623-4900

Policies (SoA and UW):

Equal Opportunity

In concurrence with the University of Washington's core values, and in compliance with State and federal regulations, the School of Art + Art History + Design reaffirms its commitment to equal opportunity. The commitment extends to the recruitment of faculty, staff, and students who exhibit a dedication to creative and academic excellence and who demonstrate the ability to work with a diverse spectrum of populations.

Diversity

The School of Art + Art History + Design fosters a respectful, inclusive community that supports creative and critical expression and scholarship amidst a culture that accepts the value of every individual. The School encourages students, faculty, and staff to engage in healthy dialogue and respect the values and global perspectives of a diverse population. The School promotes and encourages a culture of compassion, understanding, and an obligation to respectful discourse in classrooms, meeting rooms,

studio spaces, and beyond. The School's philosophy is reflected in our engagement with community partners and research endeavors locally, nationally, and globally.

Student Code of Conduct

The University of Washington has established rules regarding student conduct. Through the Student Conduct Code, UW students hold themselves to the highest standards of ethics, integrity and accountability. More information at [UW Community Standards & Student Conduct \(CSSC\)](#).

Violence Awareness and Prevention

- Preventing violence, discrimination, harassment, and retaliation is everyone's responsibility
- Call 911 for emergency help
- Call (206) 685-SAFE to report non-urgent threats or concerns
- [Safe Campus](#)
- [Concerns about sexual harassment](#)
- NightRide provides a fare-free safe way for U-Pass members to get home at night:
www.washington.edu/facilities/transportation/uwshuttles/NightRide
- Connect to UW Alert. Register your mobile device to receive instant notification of campus emergencies via text and voice messaging. [Sign up for UW Alert here](#).

Student Health + Wellness

Student health and well-being are important. UW Seattle offers a wide range of health and wellness services, from exceptional medical care and counseling services to recreation classes, safety resources, peer health advocacy, trainings and more. These can be found at wellbeing.uw.edu

First Day Attendance Policy

Instructors assume that if you are not present for roll call on the first day of a Design course you have decided not to remain enrolled. Therefore you will be required to drop the class. This policy applies to all students: in-state, out-of-state and international. Note that [U.S. Visas for international students may be revoked if students are not on time for the beginning of the academic quarter](#).

Also note that a delayed return from Summer, Winter or Spring Break is not considered a valid excuse. The starting times and dates of UW instruction are published well in advance each year, enabling all UW students to plan their schedules accordingly. [For more information on why this policy exists please read this page](#).

Participation in Class

Participation is essential to learning and success in all classes. In design classes participation is figured as part of your grade. If you miss class due to illness or emergency, notify your instructor, provide documentation, and set up a timeline to complete missed assignments and exams.

Disability Accommodation

- To request academic accommodations due to a disability, please contact Student Disability Services, 448 Schmitz, (206) 543-8924 (V/TTY) or uwdss@u.washington.edu.
- Your instructor will receive an email outlining your academic accommodations prior to the first day of class. It is a good idea to discuss these accommodations directly with your instructor to ensure that your instructor can help you with your needs.

Examination Schedule + Attendance Policy

Final exams are scheduled by the University and cannot be changed. Students are required to turn in assignments and take exams based on the timeline provided in the class syllabus. If the instructor has scheduled an in-person final critique/project turn-in, all students in the class are required to be present. An individual student will not be permitted to submit work early and skip the in-person final unless there are exceptional personal circumstances. Note that the desire to leave early for holiday travel or personal reasons does not qualify as an exceptional circumstance. [More information can be found here](#).

Concerns About a Course, an Individual, or an Issue

- If you have concerns about a course, an individual, or an issue concerning the School of Art + Art History + Design, talk with the instructor in charge of the class as soon as possible.
- If this is not possible or productive, make an appointment with the Director of Academic Advising, 104 Art, (206) 543–0646 or the Director of the School of Art, 102 Art, (206) 685–2442.

Plagiarism

- Plagiarism is using the creations, ideas, words, inventions, or images of someone else in your own work without formal acknowledgement or permission. This applies to written papers and research as well as to art, design and architectural images.
- Please check with your instructor if you have questions about what constitutes plagiarism.
- Instances of plagiarism will be referred for disciplinary action to the Vice Provost for Academic & Student Affairs. [More information about reporting academic misconduct.](#)

Copyright

- The School regularly displays student art and design in a variety of ways to highlight the quality of our students and their learning.
- This is traditional among all art schools and we assume that by participating in UW School classes and activities students have no objection.
- If you have concerns about the use of your work, please contact Academic Advising and Student Services (206–543–0646 or uaskart@uw.edu)

Incomplete Grades

To request an “incomplete” grade a student must have been in attendance and done satisfactory work through the eighth week of the quarter and satisfactory proof for the instructor that the work cannot be completed because of illness or other circumstances beyond their control. [More information from the UW Office of the Registrar.](#)

Grade Appeal Procedure

- If you think the grade you received is incorrect, contact the instructor to discuss your concern.
- If not resolved, make an appointment with the Director of Academic Advising, 104 Art, (206) 543–0646.

Materials Fees

- All art, design and art history classes have materials fees billed with tuition.
- Fee amounts and justifications are listed by class in the quarterly Time Schedule.
- These fees cover the purchase of materials, academic support, and equipment provided for students in each class.

Service Animals

- The University has a general “no pets” policy in all of its buildings. However, Service Animals are allowed to accompany their handlers while on campus
- UW Disability Resources for Students outlines the policies around [Service and Emotional Support Animals.](#)

Religious Accommodation

- Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities.
 - The UW’s policy, including more information about how to request an accommodation, is available at [Religious Accommodations Policy.](#)
 - Accommodations must be requested within the first two weeks of this course using the [Religious Accommodations Request form](#)
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Weekly Outline: *(Subject to change)*

Week 1: Introduction / 2D CAD - Solidworks

Day 1: Introduction / 2D CAD – Tues 3.30

- Review syllabus, quick introduction and overview, SolidWorks overview
- 2D CAD – sketch format / planes, line types, editing, patterns, smart dimensions, sketch relations / constraints
- Exercise 1: Class overview

Day 2: Digital tools overview / 2D CAD expanded / 3D basic – Thur 4.1

- Expand on 2D CAD functions, sketch constraints, dimensioning & export for laser cutter, start 3D CAD basic – extrude (and drafted), extrude cut, shell, edit feature (feature tree), additive / subtractive features, approaches / strategies, work flow
- Exercise 2: Box bracket, Ortho view sketch import / trace, basic drawing export for Illustrator
- In-class work session

Week 2: 3D CAD (basic part / multi-body part) - SolidWorks

Day 3: 3D CAD (single part construction & basic drawing) – Tues 4.6

- 3D CAD (continued) – extrude, cut, solid edits (fillets / chamfer), revolve, modify feature (feature tree), basic drawing creation (Legos), basic evaluate (measure), revolve cut
- Exercise 3: Legos reverse engineer , Flash light (model / drawing), vase / planter pot

Day 4: 3D CAD (multi-body part construction) – Thur 4.8

- 3D CAD (continued) – combine solids (add / subtract), revolve continued, sweep, dome, move, copy, scale, patterns, mirror, shell, multi-body parts
- Exercise 4: Flashlight (model & drawings), Paper clip, Planter pot w/ handle and base

Week 3: 3D CAD (multi-body parts & assemblies) - SolidWorks

Day 5: 3D CAD (multi-body parts & assemblies) – Tues 4.13

- 3D CAD (continued) – sweep continued, loft basics, revolve / sweep cuts, assemblies, grip cuts
- Exercise 5: Vase handle continued (sweep), Flashlight continued, (patterns & grip parts), Basic loft part

Day 6: 3D CAD (assemblies & drawings) – Thur 4.15

- 3D CAD (continued) – revolve review, grip cuts, loft continued, split parts (shelled), assemblies, exploded views, assembly drawing layout, BOM's, part properties
- Exercise 6: Basic loft parts, Coffee cup handle (loft), Cork screw, USB (split & assembly)

Week 4: 3D CAD (drawings, analysis, & renderings) – SolidWorks / KeyShot

Day 7: 3D CAD (drawings & analysis) / Digital Output for .stl – Tues 4.20

- 3D CAD (continued) – basics of rapid prototyping / applications, preparation and export of CAD files (STL), analysis of parts (surfacing & loft)
- Exercise 7: Loft to point, knife handle

Day 8: KeyShot (rendering) – Thur 4.22

- Introduction to KeyShot, interface, import / export, materials, lighting, environments, cameras
- Creating silhouettes in Illustrator / Photoshop, contextual / hero / detail renderings
- Exercise 8: STL – USB export, Cork screw, USB stick continued (door stop, ear buds), Silhouettes

Week 5: Physical Output / Intro to CNC / Rhino CA28

Day 9: CNC Intro / Hand form studies– Tues 4.27

- Overview of CAM / CNC basics – relationship to design process (lecture)
- Exercise 9: 3 axis demo, form study demo

Day 10: Loft construction / Rhino CAD basics – Thur 4.29

- Extracting data points from handle grip prototypes & loft construction, rubber grip cuts
- Basic interface, navigation, import, and edit functions in Rhino
- Exercise 10: Handle grip loft layout, Rubber grip cut-out, Object (stack, move, copy, rotate) – Rhino CAD

Week 6: Rhino CAM / Digital Output - CNC

Day 11: Rhino CAM 2.5 & 3 axis – Tues 5.4

- Introduction to preparing files for Rhino CAM, Rhino CAM functionality and tool paths for 2.5 and 3 axis milling
- Exercise 11: Donut gasket (2.5 axis), Mouse (3 axis)

Day 12: CAD / CAM Catch up – Thur 5.6

- In-class work session and continued CAM preparation
- Exercise 12: Layout and approach for handle grip Rhino CAM

Week 7: 3D CAD – Advanced Surfacing (SolidWorks) / 2D Tools – Adobe (Photoshop)

Day 13: Advanced Modeling in SolidWorks – Tues 5.11

- Surface modeling (extrude revolve, loft, knit), replace face, surface cuts, freeform, projected / intersecting paths, 3D sketches,
- Exercise 13: Eye glasses (3D sketch), Spoon, brush grip, Soap bottle, Cork screw (assembly mates)

Day 14: Advanced Modeling in Solidworks– Thur 5.13

- Surface modeling approaches to solids modeling integration techniques
- Exercise 14: helix, text in SolidWorks, assembly mates, adv. fillet types

Week 8: 2D Tools in Rendering + Layout – Adobe (Photoshop, Illustrator, InDesign)

Day 15: Photoshop + KeyShot – Tues 5.18

- SolidWorks rendering (.tiffs), line work export to Illustrator, Basic overview / functionality / application for CAD renderings
- Exercise 15: Enhancing CAD renderings (shadows, textures, materials, graphics, contextual layouts)
- In-class work session (renderings & final project)

Day 16: Illustrator + Photoshop (continued) – Thur 5.20

- Basic overview / functionality / application
- Exercise 16: Image trace, CAD wireframes, logo, scanned drawing clean-up (Photoshop)
- In-class work session (final project)

Week 9: 2D rendering and visual communications

Day 17: InDesign – Tues 5.25

- Fundamentals of graphics, layout for ID presentation
- Basic overview / functionality / application – poster, presentation, book
- Exercise 15: Poster layout (OLPC laptop),

- In-class work session (final project)

Day 18: Final project work day – Thur 5.27

- In-class work session (final project)

Week 10: Final Project Work Week

Day 19: Final project work day – Tues 6.1

- In-class work session (final project)

Day 20: Final project work day – Thur 6.3

- In-class work session (final project)

Week 11: Finals Week

Day 21: Final Project Presentation – Thur. 6.10, 10:30-12:20pm

- Final project presentation, last day of class
- + *Assignment - In: Final projects due (all required final deliverables)*