

PDI Studio III: Industrial Design

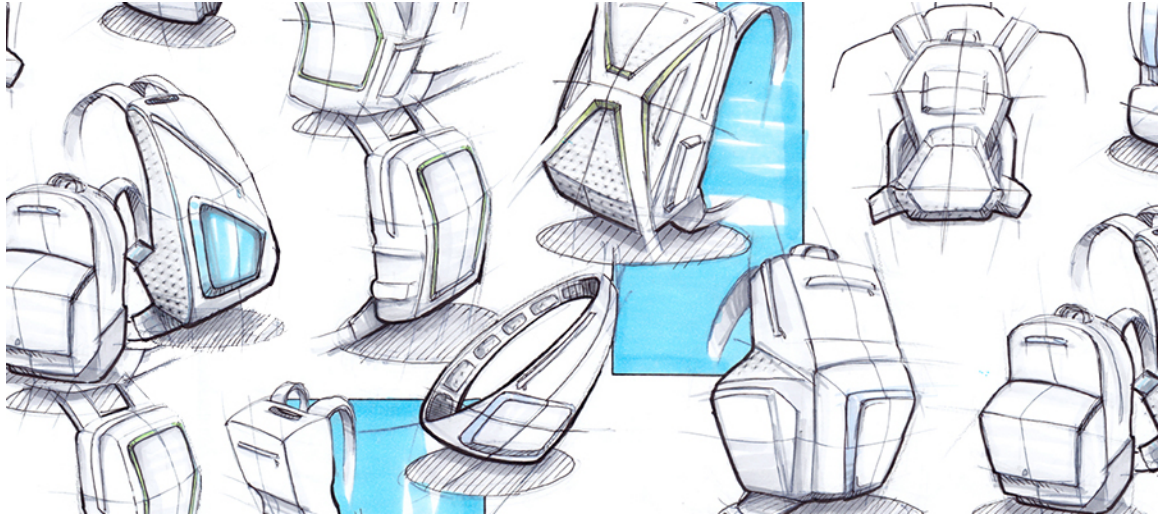
Syllabus, Fall 2018

Studios: Tuesday/Friday 2-5 PM, Sage 2211

Professor: Dr. Jim Malazita (malazj@rpi.edu)

Office: Sage 5118, Office Hours: T/F 12-1

Introduction:



This course is the third in the PDI studio series. It introduces students to general principles of user-experience design and industrial design as a set of approaches for attending broadly to matters of aesthetics and form, usability, and meaning-making. It considers industrial designers as a community of practice. Assignments require students to synthesize social, technical, and formal concerns in the design of innovative objects.

Industrial design encompasses the interests and needs of those impacted by designed artifacts. The emphasis of this course will be on product aesthetics and usability from the perspective of users; however, issues of fabrication and manufacturability, and design impacts on groups extending beyond a given product's immediate users will also be considered. According to the Industrial Designers' Society of America,

The industrial designer's unique contribution places emphasis on those aspects of the product or system that relate most directly to human characteristics, needs and interests. This contribution requires specialized understanding of visual, tactile, safety and convenience criteria, with concern for the user. Education and experience in anticipating psychological, physiological and sociological factors that influence and are perceived by the user are essential industrial design resources. (www.idsa.org; accessed 10Aug06)

Thus, industrial design can be understood as a disciplined approach—and accompanying methodologies—used to align product characteristics with human characteristics. In addition, industrial design is a community of practice. It has its own professional associations, codes of responsible practice, membership rules, priorities, and ways of understanding what “design” entails. As PDI students, you are not expected to become industrial designers (though some of you may well do so). However, you are expected to understand industrial design's basic approach

to design as well as how this community defines itself and how it is defined by others. In other words, you must become competent in industrial design practice and conversant in its discourse.

As a studio course, class time is used for self-guided design investigations as well as structured group activities. Students will participate in individual and group research; discussions with potential users, researchers, and practitioners; project reviews; and formal presentations. The course includes time for hands-on exploration of design ideas. Overall, this is a labor-intensive course that requires a sustained effort throughout the semester. Students will need to start on their projects early, reach out to testers and their group members efficiently and empathetically, and dedicate adequate time to polish, iterate, and hone their design concepts throughout the course. In general, it is expected that you will spend between 10 to 12 hours every week outside of class time on your reading, prototyping, testing, and writing. Always be thinking about your portfolio.

Daily class times are generally broken into two 1.5 hour sections: a lecture/discussion, tutorial, or design activity for the first section of class, and open studio/table critique for the second section. In general, Tuesday classes will feature discussions/criticisms of assigned readings about User Experience design, the sociology/anthropology of consumer objects, and tutorials and discussions about user experience testing/general UX principles. Thursday classes will feature tutorials and exercises about CAD modeling, rapid prototyping, and lighting-rendering-presenting product concepts.

The key component to this course is **attention to detail** across the social, aesthetic, and experience dimensions of the design of objects. This means that students will be held to a high standard of product concepting, user testing, and object prototyping/building. **A good concept that is executed poorly will result in a poor grade.**

Required Texts:

Harvey Molotch, *Where Stuff Comes From* (Routledge, 2003).
Donald Norman, *The Design of Everyday Things, Revised Edition* (BasicBooks, 2013).
Lidwell, Holden, & Butler, *Pocket Universal Principles of Design* (Rockport, 2015).

Required Software (Windows Version Highly Recommended):

Rhinoceros 3D (Version 5) <https://www.rhino3d.com/download/rhino/5/latest>
Epic Software's *Unreal Engine* (Version 4.1 and up) <https://www.unrealengine.com/en-US/download>

Required Materials:

Unlined sketchbook
Colored Pencils, Colored Markers
Prototyping Materials as Needed

Strongly Recommended Materials:

Three-button USB mouse
USB Stick, min 25 GB

Assignments and Grade Breakdown:

Design Briefs: (66 Points)

Studio Object Design – 17 points

- Pinup and Presentation – 3 points
- Rough Prototype – 5 points
- Final Concept – 2 Points
- Report– 5 Points
- Final Presentation – 2 Points

Design History Redesign – 22 Points

- Moodboard and Pinup – 3 points
- Rough Prototype – 5 Points
- Detailed Prototype – 5 Points
- Final Concept – 2 Points
- Report – 5 Points
- Final Presentation – 2 Points

Open Design – 27 Points

- Pinup – 3 points
- Research/Moodboard – 2 points
- Rough Prototype – 5 points
- Detailed Prototype – 5 Points
- Final Concept – 5 Points
- Report – 5 Points
- Final Presentation – 2 Points

Modeling Challenges: (35 Points)

Complex Curvature – 10 Points

Complex Texturing – 10 Points

Photorealistic Lighting and Texturing – 15 Points

Total: 102 points (Students begin with 2 Points of Extra Credit)

All text portions of projects (papers, write-ups, design documents) must be submitted to the course's Blackboard page before the start of class on the due date. Papers submitted must be in **.doc, .docx, or .rtf format.**

Design Reports:

For every Design Challenge Assignment, the student or group will turn in their final build and a Design Report that contains each of the following:

1. A title page that gives the name of the product, the names of each group member (or individual), and an “abstract” that describes the product in three or four sentences
2. A PDF of photos of the prototyping process, with image captions and descriptions under each image
3. A PDF of “beauty shots” of the final product, as well as the product being used, with image captions and descriptions under each image. **For the final two assignments, the beauty shots must be CAD renders using Rhino and Unreal. The expected craft of these renders will increase as students become more familiar with CAD and the rendering process.**

4. A design process statement: a 1000 word statement that describes the group's design process, the feedback from user testing sessions, and design iterations. The Design Process includes Problem Definition, Ideation, Prototyping, Building, and Testing. **The process section should demonstrate both what and why, materially and experientially, and the included user test feedback must be clear and specific.**
5. A user statement (1000 words):
 - a. You are to identify the user group(s) targeted in your project. **You should be as specific as possible in describing shared attributes of the targeted users,** focusing particularly on those dimensions that make this target user group distinct not only from dissimilar groups but also from apparently similar groups. Obvious but generalized attributes include demographic characteristics (e.g., age, gender, income), socioeconomic class, education level, geographic context, and physical and mental abilities *only as relevant*. Less obvious generalized attributes may include orientation toward consumer product innovation, high tech, (formal) design, environmental sensibility, etc. Specific attributes may include stylistic preferences, popular (media, culture) reference points, work pattern preferences, etc.
 - b. **This is a “social analysis,” not analysis of a random group of people, so be sure to talk in terms of social groups and their needs, wants, desires, and expectations.** Remember that designing for “everybody” is not really possible and is rarely desirable. The instinct to broaden or rearrange priorities when targeting user groups is a good one, but if you don't understand the boundaries of your audience, you won't be effective in reaching new user groups. Design for “everybody” is usually a euphemism for designing for “people like me” or for “middle-class American consumers.” What are the strengths and benefits of attending to the chosen group? What trade-offs do you face as a designer having selected this target user group?
 - c. To be analytically robust, you must be mindful of stereotypes as you characterize user groups. Critical reflection on your initial assumptions about the user group you have selected early in your thinking and writing process will result in stronger and more insightful analysis.
 - d. As always, you must submit a *refined* paper for this assignment. **It should include a short introduction laying out the terrain to be covered, a logically organized body that develops a clear line of argument, and a brief conclusion statement summarizing your argument.** Papers should use gender-fair language and be free of typos and writing errors.
6. A 500 word section that should be technical in nature, which would allow a manufacturing team to build your design accurately. This should include both detailed descriptions of the product, as well as material and measurement diagrams, and low-fidelity exploded views where appropriate.

The report will be graded on both the strength of the analysis and also on the strength of concept. These elements are tightly wound together.

The report will be compiled as a single PDF, and submitted to the LMS site. For group assignments, each group need only submit one collective PDF.

Design Challenge 1: Studio Object Design/Redesign

Group Size: Individual

This project entails the design (or redesign) of an object for use in the PDI studio. There is some flexibility in the type of object you choose to design, but it must be something that users *physically* interact with and it must be directly relevant to the use of the studio—by instructors, students, visitors, maintenance staff, etc. This assignment includes:

- 1) A series of 3-D mockups and rough prototypes of your proposed design in suitable materials
- 2) A concept presentation. Your presentation should be from a User Experience point of view, and should include information about your design and research process, persuasive evidence for specific design decisions based on user feedback, and some key features of your object. You will be expected to hand in a copy of your slides in PDF format.
- 3) A design report accompanied by detailed mockups/build of the design, including appropriate 2-dimensional representations of 3-D models.

This is an *individual* project, so the objects you select for (re)design should be simple enough that you have sufficient time for each of the following steps (informed by the design process reviewed in your text from PDI Studio 1, *Product Design*):

- detailed design decision making, including appropriate iteration;
- background and mid-stream research;
- object representation including detailed sketches and modeling using 3-D software; and
- a series of progressively detailed mock-ups/prototypes representing innovative components/features of your concept.

You may collaborate with your classmates in the framing of problems and you may share your research and your design progress, but what you submit for grading at the end of the project must be the results of your own labor. All sketching/modeling, all reported research findings, all prototyping, etc. must be your own unless you note otherwise. (If you want to use someone else's research findings because they are relevant to your project, that's fine as long as the work in question is clearly attributed to its source. Similarly, receiving help with rapid prototyping is encouraged as long as you make a note of the assistance in the appendix of your report.)

You should attend carefully and systematically to usability and the emotional experience created by both your proposed design and all its supporting components, including the prototype/mock-ups and within the presentation.

This project is intended to be narrow and deep. Keep in mind, the simpler the object being (re)designed, the more attention you can pay to all the required supporting work. Thus, you are strongly encouraged to select a simple object and pay careful attention to all the details rather than over-reaching by selecting a more complex object and paying insufficient attention to detail. (Project 3 will be a more complex project, developed in teams, to provide a broader experience.)

Your designed objects may employ any materials in any configuration as long as you can justify your decisions appropriately. Material choices in particular affect cost, environmental impact, and aesthetics in addition to functional performance.

Design Challenge 2: Design History Redesign

Group Size: 2 Members

This project entails the redesign of a product series through the lens of a notable designer, design group, or design company. Student Groups will be assigned a problem statement and designer, and will have to find solutions to that problem statement using the aesthetic, philosophical, social, and manufacturing priorities of their designer. For designers that have had a long and varied career, student groups must select a particular period of that designer's work to emulate.

The problem statement is both broad and specific. It will identify a particular user experience problem (e.g., "I am cold at night"), but will not identify the user themselves. The student groups must decide on an imagined user group for that problem statement. This decision is important, as it will direct their design decisions and user testing protocols (i.e., you must test your product with the chosen user demographic). However, students have wide latitude in interpreting the UX problem (there are many reasons why an individual may be cold at night, and there are infinitely more potential solutions to that problem).

A constraint of the project is that student groups must design a product series (of three objects) as the solution to the UX problem, and that series must be recognizable as products that are intended for home consumer use (think, "what would I find in an IKEA, or in the home goods section of a target?"). Students are allowed a wide gamut of the variability of the individual objects in a product series. The three objects may be similarly-themed pivots off of a single concept (e.g., three kinds of forks); a continuum of related objects (e.g., a fork, a spoon, and a knife), or a set of three interrelated objects (e.g., a sugar spoon, a teapot, and a breakfast tray). Importantly, the objects must be recognizable as a set to users.

Often, that recognition will manifest through the interpretation of the assigned designer's style and philosophy upon the object series (for example, what might a set of spoons designed by late-career Frank Lloyd Wright look like and operate like?). Though the assigned designers will have a wide array of product and architectural examples, they will not have developed many (if any) of the user problems assigned to the student. The student must be able to identify how the priorities of their designer have translated into a new medium.

Student groups must balance their designer values with their growing knowledge of user testing and experience—not all of the designer's choices or styles will be good ones for the users of your product series. Through a combination of user testing, multiple iterations of design, and application of the principles covered in class, student groups must also continue to make the product useable for a target audience—though that audience, and the specific functions the object series accomplishes, may overlap with your designer's audience (on the other hand, you may choose to have it not overlap!).

This project will entail:

- A mood board/historical research of your designer and their design philosophies and practices
- A **critical interpretation** of those practices
- Multiple physical prototypes
- A design report that includes a description of their assigned designer
- A formal presentation with prototypes and beauty shots

Design Challenge 3: Open Design

Group Size: 3 Members

This project entails the design (or redesign) of a *real-world* object of your choice. As with Project 1 and 2, you should pay particular attention to questions of user experience, usability, and formal/aesthetic dimensions of the design: How does the user interact with and psychologically/emotionally experience your designed object? How do the product's form, surface, and details provide the user cues as to how it should be engaged? How have you improved user experience compared to existing products?

There is considerable flexibility in objects to be designed for this project, but the objects should be something you can prototype and actually *put in the world for detailed user interaction and testing* (for complex objects, you may prototype salient components of the larger object). Your designed objects may employ any materials in any configuration as long as you can systematically justify your decisions, though they must still fit under the broad category of "things you could find in a home goods store." Material choices in particular affect cost, environmental impact, and aesthetics in addition to functional performance. Mechanical contraptions are allowed, but strongly discouraged. I cannot stress enough: the more complicated the object is mechanically, the more complicated will be design and prototyping, the more difficult it will be to keep the form simple and elegant, and the less time you will have for user experience design. Concepts must be instructor approved.

This assignment entails:

1. A professional **design report** highlighting research findings and delineating relevant design specifications, including generous use of appropriate 3D visualizations of your design (a sample outline for this report is provided on the reverse);
2. A series of **mockups and prototypes** of your proposed design in suitable materials and appropriate resolution for each stage of design, with a *high-res* prototype;
3. A **stand-alone poster** that communicates the design concept, the problem it solves, and its key features in terms of usability and aesthetics; and
3. A **formal presentation** with prototypes and poster on December 11th.

Attention to user experience, usability, and formal/aesthetic characteristics should be given to all components of this project, including supporting documentation. This project is intended to provide a broader design experience than Project 1 and 2, but you must also achieve considerable *depth* in your project's design. *User experience should be addressed explicitly and systematically across all facets of your project.*

Modeling Challenges

Group Size: Individual

Students will be presented with three Modeling Challenges throughout the semester—2-week, highly constrained modeling sprints that are designed to both students to push their modeling and texturing work beyond the foundational lectures covered in class, as well as to demonstrate their growing competence with Rhino and Unreal. Students will be assigned a particular object or scene to model, texture, and light, and must submit both renders of their assignments, as well as the Rhino or Unreal files used to construct the scene.

Grading will be based upon demonstration of the understanding of Rhino and Unreal toolsets, as well as on the aesthetic qualities of the final renders and attention to detail in modeling, texturing, and lighting. There are many ways to model and texture the same object or scene, so students should feel free to take a modeling or texturing approach that they feel will yield the best end results. For each assignment, students should be paying special attention to:

Challenge 1: Form and curvature, detail modeling, manufacturing seams, physically-real edges, internal form (where appropriate).

Challenge 2: Displacement, alpha, material properties, physically-real wear, fidelity in close-ups and distance shots.

Challenge 3: Shadow maps, appropriate lighting for chosen time of day, physically-real wear, non-duplicated appearing objects, volumetric effects, realistic lighting, shading, reflection, fidelity in close-ups and distance shots.

Schedule:

Week	Assignments Due	Tuesday Class (Discussions & Studio)	Friday Class (Lab & Studio)
Week 1, August 31st			Welcome & course overview Discuss: <i>What is good user experience?</i>
Week 2, September 4th and 7th		Read: <i>DOET</i> Ch 1 & 2 <i>Principles</i> 1-30	3D Modeling Basics Introduction to Rhino (Box, Hole, Glass)
Week 3, Sept 11th and 14th	Project 1 Pinups Due in Tuesday Class	Read: <i>DOET</i> Ch 3 Read: <i>Principles</i> 31-60	Lofting simple surfaces, working off of reference images
Week 4, Sept 18th and 21st	Project 1 Rough Prototype Due in Tuesday Class	Read: <i>DOET</i> Ch 4 & 5 Read: <i>Principles</i> 61-75	Complex surfacing Rhino Challenge 1 Assigned
Week 5, Sept 25th and 28th	Project 1 Final Due Monday Night	Read: <i>DOET</i> Ch 6: Read: <i>Principles</i> 76-90 Project 1 Presentations	Roughing out concepts in CAD, Subsurface modeling Project 1 Presentations
Week 6, October 2nd and 5th	Complex Curvature Rhino Challenge 1 Due Monday Night		Advanced modeling techniques (blocks, displacement, rendermesh), Translating Rhino to 3D Printing

Week 7, October 9th and 12th	Woodshop Training Must be Completed	Following a Monday Schedule	
Week 8, Oct 16th and 19th	Project 2 Moodboard and Pinups Due in Tuesday Class	Read: <i>Principles</i> 91-105	Texturing 1: Prepping UVs in Rhino, Importing to Unreal
Week 9, Oct 23rd and 26th	Project 2 Rough Prototype Due in Tuesday Class	<i>Stuff</i> Preface & Ch 1	Texturing 2: PBR Basics Rhino Challenge 2 Assigned
Week 10, Oct 30th and November 2nd	Project 2 Detailed Prototype Due in Tuesday Class	Read: <i>Stuff</i> Ch 2 & <i>Principles</i> 106-120	Texturing 3: Complex materials, animated/ procedural materials
Week 11, Nov 6th and 9th	Project 2 Final Due Monday Night	Project 2 Presentations	Lighting 1: Basic Lighting
Week 12, Nov 13th and 16th	Complex Textures Rhino Challenge 2 Due Monday Night	Read: <i>Stuff</i> Ch 3 Read: <i>Principles</i> 121-135	
Week 13, Nov 20th and 23rd		No Class	Thanksgiving
Week 14, Nov 27th and 30th	Project 3 Pinups Due in Tuesday Class	Read: <i>Stuff</i> Ch 4 & <i>Principles</i> 136-150	Lighting 2: HDR, environmental lighting
Week 15, December 4th and 7th	Project 3 Rough Prototype Due in Tuesday Class	Read: <i>Stuff</i> Ch 5 & 6 Read: <i>Stuff</i> Ch 7 & 8	Open Tutorial Final CAD Challenge Assigned
Week 16, December 11th	Project 3 Detailed Prototype Due in Tuesday Class Presentation, and Tuesday's Class	Final Presentations	

Finals Week, December 21st	Project 3 Final Report Due Monday Night, December 17 th Poster Due to Jim's office (Sage 5116) by December 21st Photorealistic Lighting Final Challenge Due December 21 st	Final Report	CAD Challenge 3
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Late Assignment Policy:

Pinups and Prototypes are due at the beginning of class. Writeups and Project Reports are due to LMS at the end of the day. Late assignments will suffer a penalty of one letter grade for each day late.

Attendance:

Students are expected always to be present during class and recitations. Attendance will be taken at the beginning of each class. Excellence in submitted work will not make up for delinquency in attendance. **More than three unexcused absences will result in a lowering of your final course grade by one mark for each unexcused absence after 3. More than seven absences will result in the failure of the course. Three late arrivals will equal one missed class.** If you must miss a class, assignments are due before the class period begins. Excusable absences include illness, family emergencies, and scheduled Rensselaer athletic events. All excused absences must be delivered to the professor via the Office of Student Life.

Academic Integrity:

Student-teacher relationships should be built on trust. Students should be able to trust that teachers have made responsible decisions about the structure and content of the courses they teach, and teachers must trust that the assignments students turn in are their own. Acts that violate this trust undermine the educational enterprise and contradict the very reason for your being at Rensselaer. *The Rensselaer Handbook of Student Rights and Responsibilities* defines various forms of academic dishonesty and procedures for responding to them. The policies laid out in the *Handbook* are intended to maintain a community of trust and will be strictly enforced. Please review these policies.

For this course, the following penalties will apply:

- Significant acts of plagiarism (e.g., text copied verbatim from an unidentified source): Failure of the course and a written judgment in the student's official record
- Minor acts of plagiarism (e.g., referencing the findings of others without appropriate citations): Failure of the assignment, plus reduction of final course grade by one letter grade

Other acts of academic dishonesty: Penalties range from a warning to reduction of final grade by one letter grade to failure of the course, depending on the severity of the violation as determined by the instructor

As is evident above, penalties for plagiarism are significant. All direct use of another person's words must be placed inside quotation marks. You must also indicate where you paraphrase another's work and where you borrow another's specific ideas or interpretations. If you have questions regarding proper citation practices, see the instructor for clarification *before* the assignment is submitted.

While collaboration is encouraged throughout the course, others cannot do work for you. All assignment activities must be carried out by the individual or team members submitting the assignment for a grade. Other people may show you *how* to do something (say, when using computer software), but you must follow up by doing the work yourself.

The Rensselaer Handbook provides specific procedures by which a student may appeal a grade. You should speak to the professor before initiating an appeal. If this does not lead to satisfactory resolution, you have the option of appealing your grade by writing to the head of the STS Department no later than 10 days after your grade has been posted.