

University Of California, Berkeley

DES INV 15: Design Methodology (3 units)
Undergraduate Elective Course

Draft Syllabus

CATALOG DESCRIPTION:

This introductory course aims to expose you to the mindset, skillset and toolset associated with design. It does so through guided applications to framing and solving problems in design, business and engineering. Specifically, you will learn approaches to noticing and observing, framing and reframing, imagining and designing, and experimenting and testing as well as for critique and reflection. You will also have a chance to apply those approaches in various sectors.

COURSE PREREQUISITES: None

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL:

Visualization, Modeling and Graphics for Engineering Design, 2nd Edition, Dennis Lieu and S. Sorby, Cengage Publishers, 2017.

Scenario-Focused Engineering, Austina De Bonte and Drew Fletcher, Microsoft Press, October 2014.

The Service Innovation Handbook, Lucy Kimbell, 2015.

Notes on Problem Finding, Problem Solving, Sara Beckman (online).

COURSE OBJECTIVES:

To introduce the design mindset, skillset and toolset, their scope, and their limitations.

To provide exposure to the practice of design through application in multiple settings.

To encourage understanding of the broader implications of designs that you create.

DESIRED COURSE OUTCOMES:

Development of a design mindset around doing observation, framing and reframing, imagining and designing alternative concepts, iterating to learn, critiquing and reflecting.

Development of an appreciation for different perspectives on design (i.e., engineering, design, business).

Development of basic capabilities to visualize or represent solutions in different modalities.

Development of fundamental skills for working effectively in a team environment.

TOPICS COVERED:

Observation (taking in data from the physical world, particularly about the intended customers and users of a design and about other stakeholders engaged in a design effort); framing and reframing problems (getting to why, ensuring that the focus of the design effort is on solving a meaningful problem, adjusting problem frames as needed); diverging to generate solutions and converging to select among them (concept generation methods, concept selection methods, practice in distinguishing when to do each, imagining alternative futures); experimentation and testing (building prototypes, identifying key areas of risk, conducting experiments) to develop understanding of the iterative nature of design; critique and reflection as mechanisms for individual learning and supporting learning of others; survey of computer aided design tools; patents; product liability; case studies in failure; failure mode analysis; engineering ethics.

CLASS/LABORATORY SCHEDULE: Two 1.5 hours of lecture per week

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Students learn the basic design process, but also learn limitations and expectations from social, political, ethical, and legal perspectives. Students will be formally trained in how to work effectively in teams.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

- Individual homework assignments: 20%
- Team project deliverables: 20%
- Participation in team projects: 15%
- Participation in class discussions: 20%
- Final team project presentation with external judges: 25%

SAMPLE OF WEEKLY AGENDA:

The following agenda includes four applications of the design process, each longer and more complex than the last so that students experience it multiple times and build their capabilities over the course of the semester.

Week	Topic	Design Activity
1	Introduction to Design	Design Exercise #1: Full cycle (e.g., redesign the commute); working in pairs
2	Customer-focused Design: Understanding Customers	Design Exercise #2: Partial cycle (e.g., redesign fruit consumption) Develop understanding of the problem space
3	Customer-focused Design: Generating and Testing Concepts	Design Exercise #2: Continued Create alternative solutions and visualizations
4	Engineering-driven Design: Working in teams Formation of project teams for design exercise	Design Exercise #3: Partial cycle, as they are given the problem to be solved (e.g., arrow puller);

	#3, drafting of team contract Problem framing, ideation, structured search, selection matrices	working in teams of 4
5	Graphical communications and visualization	Design Exercise #3: Continued Share solutions, create visualizations of them
6	Patents: Identification of independent and dependent claims, infringement analysis	Design Exercise #3: Continued Patent evaluation, redesign solution
7	Critique and reflection	Design Exercise #3: Continued Present and test solution
8	Understanding customers and stakeholders: conducting observations and interviews	Design Exercise #4: (e.g., commute improvement, transportation system); working in teams of 4-6 Launch new team (collaborative plan) Customer insights
9	Understanding customers and stakeholders: framing and reframing Interviewing and observation techniques	Design Exercise #4: Customer insights
10	Generating and selecting options: design heuristics, use of metaphors, morphological matrices, concept selection matrices	Design Exercise #4: Mechanical dissection Concept generation and selection
11	Prototyping and testing: alternative means of representing solutions including, e.g., hand-built models, 3D printing; experimentation with customers Product safety and liability	Design Exercise #4: Testing Team evaluation and feedback
12	Prototyping and testing: failure analysis Failure case study #1	Design Exercise #4: Testing
13	Business model creation Failure case study #2	Design Exercise #4: Creating final solution
14	Storytelling Ethics case study	Design Exercise #4: Presentation drafting
15	READING/RECITATION	Design Exercise #4: Dry run of final presentation
Final	FINAL EXAM	Presentations for panels of judges; innovation tournament

SAMPLE HOMEWORK ASSIGNMENTS

Teaming Homework (can be repeated across projects)

1. Develop a Collaborative Plan for your team. Using the Collaborative Plan template (shared across project-based courses in the design certificate), identify Goals, Roles, Procedures and Relationships for your team experience. The contract must be signed and dated by every member of the Team.
2. Complete the mid-project team evaluation providing an assessment of your team and 360 feedback on your teammates (shared across project-based courses in the design minor).
3. Update your team's Collaborative Plan
4. Write a reflection on your team's performance during the semester (team reflection and individual reflection)

Design Project #1 Homework

1. Write a reflection on design experience in the first class. In which parts of the process did you feel most and least comfortable? In which areas would you like to focus during the semester?

Design Project #2 Homework

1. Perform an observation (around the topic of the design exercise). Apply what you have learned about observing. In what ways do you see the situation (around the topic of the exercise) differently than when you started? What assumptions did you hold about the topic that are now in question?

Design Project #3 Homework

1. Investigate current products that assist in the removal of arrows from a target. Your report should include an image of each product, a short description of its operation, its retail price, and at least two suppliers from where it can be purchased.
2. Using brain-storming and brain-writing methods, develop at least twenty different concepts for a product that will remove stubborn arrows from a target. Illustrate these ideas with sketches.
3. Develop a decision matrix to assist in the selection of a viable product, based upon reasonable product attributes and their relative importance to the product. Identify the five most viable options for a successful product.
4. Search for relevant patents on products that facilitate the removal of arrows, with target or field points only, from targets. Create a list of your findings which include the title, patent number, date, inventor(s), an image, and a short (30 words or less) summary of each patent.
 - a. What rights does a patent give the inventor? What rights are not given to the inventor? (10%)
 - b. What types of things are patentable, and what types of things are not? (10%)
 - c. Explain the difference between independent and dependent claims in a patent. Provide examples.
 - d. If your invention is similar to one that has already been patented, what features must be present in your invention in order to infringe upon that patent? (10%)
5. Based on the findings of your patent search, re-evaluate your concepts for new arrow removal devices from your previous assignment. Generate new concepts, and a new decision matrix as needed. Recommend two viable new products that will not infringe on the patents you have discovered.
6. Prepare a technical report summarizing the results of your search for arrow puller products and patents. Include all aspects of a technical report, as was outline in class. You may copy some, or all, of the material you submitted previous homework in this class to include in this assignment.

7. Prepare a final technical report summarizing the results of the design or your arrow puller, from initial concept to final proposed product. Include all aspects of a technical report, as if you were submitting the report to a client company that had hired you to develop such a product. You may copy some, or all, of the material you submitted for HW #1-3 to include in this assignment. There is a 3000 word cap on the text in the report; there is no cap on the number of figures.

Design Project #4 Homework

1. Complete an observation or interview with a customer or stakeholder for your design project. Write a summary of that observation/interview.
2. Generate 20 alternative solutions for your “how might we?” statement. Turn in sketches.
3. Build a prototype of your solution using, for example, 3D printing.
4. Test your solution with a customer or stakeholder. Write a summary of that experiment.
5. Generate 5 business models for your chosen idea.
6. Write a story to describe your chosen idea.
7. Present your final solution to a panel of external evaluators
8. Complete a team evaluation
9. Write a reflection on the project

Class-wide Homework

1. Keep a sketchbook or journal that will be checked regularly throughout the semester, and graded at the end of the term.
2. For Design Project #4, keep a team blog that captures what you are learning and the progress of your project throughout the weeks.

PERSON(S) WHO PREPARED THIS DESCRIPTION

Dennis K. Lieu, Sara Beckman

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ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): [ss completes]

TIE CODE: [ss completes]

GRADING: Letter and/or P/NP

SEMESTER OFFERED: Fall

COURSES THAT WILL RESTRICT CREDIT:

INSTRUCTORS: D. K. Lieu, S. Beckman

DURATION OF COURSE: 15 weeks

EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9

IS COURSE REPEATABLE FOR CREDIT? No

CROSSLIST: None