

Industrial Design & Human Factors

IEOR 170 3 units Spring 2020 (CCN# 28760)

Instructor

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GSI & Readers/TA

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Lecture Time & Location

Classes are from 5:10pm to 8:00pm in 310 Jacobs Hall and are a mixture of lecture and in class activities and workshops. (<http://www.berkeley.edu/map>)

Office Hours

Instructor office hours are from 12:30-1:30pm on most Tuesdays at Office 5316 in Berkeley Way West (2121 Berkeley Way near Shattuck). To schedule an appointment outside of office hours, please email 2-3 preferred days/times and the topic of discussion. Meetings can be in person or by Zoom Web Conferencing. A calendar request will be sent to you to confirm the appointment date and time. Dr. Harris is typically on campus Tuesdays and Thursdays and at her lab at the Richmond Field Station, Monday, Wednesday and Fridays.

GSIs Yishu Yan and Srikar Varanasi will have weekly office hours, to be announced after the first week of class.

Course Objectives and Approach

This course surveys topics related to the design of products and interfaces ranging from tools, devices and dashboards to presentations, machine interfaces and web sites. Design of such systems requires familiarity with human factors and ergonomics, including the physical and cognitive capacity of humans including biomechanics and the perception of color, sound, and touch, as well as familiarity with case studies and contemporary practices in human-interface design and usability testing. Students will solve a series of design problems individually and in teams.

Course Learning Outcomes

- Describe Human Factors and the various disciplines that contribute to the field.
- Describe purpose driven design and how purpose influences the design process.
- Understand and apply the iterative design process.
- Apply known physical and cognitive capacities of people to design.

- Apply anthropometry data to design.
- Describe methods of measuring force, vibration, light, posture and repetitive motion in the workplace and explain the limitations associated with each.
- Identify the primary physical risk factors associated with musculoskeletal disorders and how they can be used to assess and improve design.
- Identify various sensory systems that influence cognitive capacity.
- Describe methods of measuring attention, memory and human errors associated with design.
- Summarize approaches to product usability evaluation
- Read, analyze and apply literature relevant to design.
- Demonstrate knowledge of physical and cognitive capacity and limitations to design by applying one or both in final design projects.

Teaching and Learning Methods

- The methods utilized principally include lecture activities that utilize small group problem solving and analysis through in class activities and assignments
- Project based learning is utilized to complement materials and facilitate understanding.
- Web-based resources are used to provide essential and supplemental material for meeting the course objectives
- Students are expected to utilize BCourse resources to learn material presented in the course. A course calendar outlines assignment due dates. It is expected that the student will have completed the readings and assignments prior to attending class as indicated.
- BCourse is organized by week in modules. Each weekly module includes a Course Guide that outlines assignments and provides links to lecture and other resources pertinent to the material for that week.

Texts & Articles

- Required reading includes chapters, handouts and articles available on BCourse
- Recommended Text Book: Designing for People: An Introduction to Human Factors Engineering 3rd Edition by John D. Lee, Christopher D. Wickens, Yili Liu, Linda Ng Boyle

In Class Activities

Every class will have a graded in-class activities. Design happens in teams; thus communicating and collaborating with teammates is an important skill to hone in this class. More than half of the in-class assignments pertain directly to your final project and are handed in and graded as a group. Therefore, it is important that you attend class and be an active participant. **Group members will be asked to rate themselves and their teammates in regards to attendance, effort and participation on in class activities and projects.** Final/Overall grades may be lowered up to one letter grade (A- to a B+ or B+ to a B) based on group participation ratings (see below). Additionally, each GSI will serve as a project mentor for 5-8 groups and will be checking in with

design project groups each week. Since it is understood that life sometimes prevents students from attending class, the lowest in-class activity will be dropped from your attendance grade. If for some reason, you are not in class but participating remotely, please make sure that you have PRIOR approval from your group members AND you must write that you were working remotely on the class assignment.

Assignments

There are 9 assignments that will be graded. Assignment descriptions can be found under “Assignments” in bCourse starting the day it is assigned. All assignments are due BEFORE class on the date published and MUST be posted to bCourse. Late assignments will NOT be accepted, however your lowest assignment score will be dropped. It is the student’s responsibility to seek clarification regarding the requirements for any assignment if the student has questions or is unclear about those requirements. Some assignments will be individual, and some will be turned in as a group (the same group as Design Project Groups).

Final Design Projects

Final design projects will be completed in groups of 5 individuals. Design projects must be purpose based, undergo the iterative design process and include an adequate usability evaluation methodology. Design projects can be selected from problems presented during the first four weeks of class, or can be identified by the group. Design topics should be identified by Week 6. A mid-semester summary will present the design problem, design goals, task demand and human capacity limitations addressed through design. The final report will improve on the mid semester outline and include an in-depth summary of the iterative process applied and the methodology used. Groups will produce a poster to summarize their project, a prototype to demonstrate their design and hand in a final report at the end of the semester. A full description of each can be found under “assignments” on bCourse.

Group Participation

As previously mentioned, effective design happens as part of a team. Collaboration, communication and meaningful participation within your group is critical to this class. Individual contributions to each group will be assessed by your group members mid semester and at the end of the semester; lack of participation (either on in class assignments, group assignments and/or project) may reduce your overall grade by one letter grade (B+ to a B; B- to a C+). Group ratings will remain anonymous, though your Project Mentor will be see and contribute to your Group Participation rating. Groups that are struggling with group member participation should first try to discuss among their team, then should consult with the Professor or GSI as soon as possible in the semester.

Written Assignment Standards

All written assignments and projects will be evaluated based on whether it meets these standards. Points will be deducted for errors in these areas.

Requirements for all written assignments:

- computer based and electronically submitted via bCourse
- Standard written English
- Standards of scientific writing as published in the *AMA Manual of Style*, including reference citations, reference list and 1.5 spacing

Grading:

In Class Assignments	10%
Assignments (9)	15%
Mid-Semester Project Outline	5%
Mid Term Exam	15%
Final Project Presentation (Poster & Prototype)	20%
Final Project Report	20%
Final Exam	15%

Calendar

Wk	Date/ Instructor	Topics/ Lectures	In Class Activities * submit online	Assignments
1	22-Jan	An Intro to Human Factors & Ergonomics		
	Harris	Course Introduction Purpose Driven Human-Centered Design Searching the literature to explore a problem	A Purpose Driven Design Problem*	<ul style="list-style-type: none"> Refer to weekly module for reading assignments. Assignment #1: 1 slide and 60 seconds. Assignment #2: Defining the Problem
2	29-Jan	An Overview of the Design Process		
	Harris	The Design Process: Lecture on ideation, brainstorming and the iterative process	Getting to know your classmates Designing a Bridge*	<ul style="list-style-type: none"> <u>Assignment #1 DUE</u> Refer to weekly module for reading assignments.
3	5-Feb	Case Studies in Design Purpose Driven Design Examples		
	Van Engelhoven (SuitX) Rao (Tesla)	Developing exoskeletons that augment the industrial worker. Human Centered Design at Tesla	Case Study Reflection*	<ul style="list-style-type: none"> <u>Assignment #2 DUE</u>
4	12-Feb	Designing to Enhance Physical Performance		
	Harris	Ergonomics as a driver of design; Balancing Task Demand & User Capacity When Design Fails; Physical exposures,	Task Analysis - Making a Bed*	<ul style="list-style-type: none"> Refer to weekly module for reading assignments. <u>Assignment #3 Examples of</u>

		thresholds and common MSDs		poor design
5	19-Feb	Biomechanics and Motion Studies in Design		
	Harris Cort (Univ. Windsor)	Project Ideation (Groups Assigned After Class) Lecture on kinematics, biomechanics and Motion Capture Case Studies Using Simulation to Assess/Refine Design	Quantifying kinematics and other exposures using video analysis*	<ul style="list-style-type: none"> • Assignment #3 DUE • Refer to weekly module for reading assignment • Assignment #4 Task Analysis
6	26-Feb	Minimizing Risk through Design		
	Harris Fathallah (UC Davis)	Making sense of exposure; using risk assessment tools to quantify improvements in design. Ergonomics in Agriculture	Application of Risk Assessment Tools*	<ul style="list-style-type: none"> • Refer to weekly module for reading assignment. • Assignment #5: Estimating risk
7	4-Mar	Anthropometrics in Design		
	Harris	Designing for extremes: identifying design parameters.	Identifying target parameters for your project.*	<ul style="list-style-type: none"> • Assignment #4 DUE • Refer to weekly module for reading assignment. • Assignment #6: Write your own exam.
8	11-Mar	Rapid Prototyping & Usability Evaluation		
	Harris Dan Odell (Google)	Test & Evaluation of Function and Form Test & Evaluation drives design: the development of the Microsoft Natural Mouse	Develop objective and subjective methods to evaluate your design.*	<ul style="list-style-type: none"> • Assignment #5 & #6 DUE • Refer to weekly module for reading assignment. • Assignment #7: Design Project Conception Sketches.

9	18-Mar	MID TERM EXAM		
10	25-Mar	SPRING BREAK		
11	1-Apr	Designing to Enhance Cognitive Performance: Part 1		
	Harris	Visual acuity, Contrast, Color Vision Systems Auditory, Tactile and Vestibular Systems Memory, varieties of attention, time sharing and multitasking	Modeling perception-reaction time and movement time*	<ul style="list-style-type: none"> • Assignment #7 Due • Refer to weekly module for reading assignment.
12	8-Apr	Sharpening your Project		
		Project Development Workshop & Meetings	Project Meeting attendance*	PROJECT OUTLINE DUE TUESDAY APRIL 7th by MIDNIGHT
13	15-Apr	Designing to Enhance Cognitive Performance: Part 2		
	Harris Mosier (IEA President)	Control types, usage, and guidelines Perceptual, mental model-based, and attention-based, and memory-based display principles Applying a systems approach to the development of shared mental models under conditions of time delayed communication at the International Space Station.	Designing to prevent errors in your design*	<ul style="list-style-type: none"> • Refer to weekly module for reading assignment. • Continue working on your projects
14	22-Apr	Designing to Enhance Cognitive Performance: Part 3		
	Harris TBA	Reason's model of human error and error mitigation Reducing errors in the hospital.	Writing Error Proof Instructions*	<ul style="list-style-type: none"> • Assignment #8: Design errorless instructions for your product

				<ul style="list-style-type: none"> Refer to weekly module for reading assignment.
15	29-Apr	User Interface Design & Evaluation		
	Harris Anna Pereira (Google)	Evaluation Methods in HCI & Software Design How research & evaluation drive design.	Video/ Website Design Assessment*	<ul style="list-style-type: none"> Assignment #8 DUE Assignment #9: Write your own final exam question.
16	4th -8th - May TBA	Design Showcase in Jacob's Hall		
		VC Fast Pitch Project Presentations <i>Each group presents their ideas to "Venture Capitalists" using a poster and prototype to present their idea.</i>		<ul style="list-style-type: none"> Assignment #9 DUE Tips for Presenting your Design Idea on Poster (Online) FINAL PRESENTATION, PROTOTYPE & REPORT DUE
17	May 15th 3-6pm	Final Exam		

* In Class Activity must be submitted during class