SYLLABUS
HSD 410/510 Device Design in the Health Sciences: Developing Tools for Healthcare Solutions using Design Thinking
Spring 2022

Time: Tuesdays and Thursdays 1:00 pm to 3:00 pm

Location: Health Sciences Innovation Building 605

Instructor(s) and Contact Information:
Travis Sawyer, tsawyer9226@arizona.edu
Assistant Professor of Optical Sciences and Health Sciences
Bioscience Research Laboratory 324, he/him/his

Textbooks: Biodesign 2nd edition, Yock et al. (recommended)

Instructor Availability: by appointment

Catalog Description: In this course, you will work in an interdisciplinary team of your peers to gain hands-on experience developing devices for application in the health sciences. Your team will broadly aim to develop devices to address and improve health seekers' experiences within the healthcare system. The course will be organized so that you learn to apply the design thinking process—Notice, Empathize, Define, Ideate, Prototype, Test, and Reflect—to understand and clearly define the real need, explore design options/concepts, analyze options, prototype your design, and pitch your design recommendation and implementation plan. Using project-based learning techniques, this experiential learning course will enable you to learn about a subject through the experience of exploring an open-ended, student-driven topic in healthcare delivery and patient-centered service experiences. Appropriate for undergraduate and graduate students, through enhanced group collaboration and in a makerspace learning environment, you will build intellectual and practical skills in inquiry and analysis, critical and creative thinking, design and prototyping, written and oral communication, teamwork, and problem solving.

Course Description: In this course, you will work in an interdisciplinary team of your peers to gain hands-on experience developing devices for application in the health sciences. Your team will broadly aim to develop devices to address and improve health seekers' experiences within the healthcare system. The course will be organized so that you learn to apply the design thinking process—Notice, Empathize, Define, Ideate, Prototype, Test, and Reflect—to understand and clearly define the real need, explore design options/concepts, analyze options, prototype your design, and pitch your design recommendation and implementation plan. Using project-based learning techniques, this experiential learning course will enable you to learn about a subject through the experience of exploring an open-ended, student-driven topic in healthcare delivery and patient-centered service experiences. Appropriate for undergraduate and graduate students, through enhanced group collaboration and in a makerspace learning environment, you will build intellectual and practical skills in inquiry and analysis, critical and creative thinking, design and prototyping, written and oral communication, teamwork, and problem solving.

Rev. 01/01/22

Course Prerequisites: All students must have taken Calculus I. Undergraduates—Junior or Senior standing or permission of the instructor. Graduates—no additional prerequisites.

Course Format and Teaching Methods: This is an in-person workshop course that will involve in-class discussion, small-group activities, and group projects. D2L will be used extensively. We will primarily use active learning strategies in this course.

Time Commitment: Based on UA's Academic Policy on earning units of credit, you should expect to complete 75 hours of work outside of class to satisfy the requirements for this 3-unit course. That equates to approximately 5 hours per week, outside of class, spent on work for this course (9 hours per week total). See http://catalog.arizona.edu/policy/credit-definitions for details.

Note that the same requirements apply to all your courses, so budget your time accordingly. A 1-unit course would require 2 hours outside of class each week, and a 2-unit course would require 4 hours outside of class to be successful. This course has stronger emphasis on in-person activities and therefore has a smaller out-of-class time expectation.

Course Objectives and Expected Learning Outcomes:

Course Objectives:
During this course, you will be exposed to design thinking and problem-solving principles, and you will gain experience applying those principles to identify challenges faced by health seekers within the healthcare system. You will gain experience understanding the problem from various perspectives, generating multiple ideas, and exploring solutions through prototyping and testing. You will learn to operate in an interdisciplinary team, and your team will broadly aim to develop devices to address and improve health seekers' experiences within the healthcare system.

Expected Learning Outcomes (Competencies Obtained):
By the end of the course, you will be able to:

Undergraduate
- Apply the steps in the design thinking process to identify an authentic need or opportunity that affects the patient experience and design and implement a solution based on developing a device.
  - Describe the role of empathy in design thinking and interface directly through observation / interviewing with healthcare professionals.
  - Apply awareness of cultural values and practices to the design and implementation of solutions.
  - Define and frame problems as a basis for further problem solving.
  - Generate a variety of unique ideas.
  - Critically analyze and refine potential solutions.
  - Design a device to address a need in the health sciences.
  - Use sketching, modeling, and prototyping techniques to conduct experiments and refine the idea.
- Give and receive constructive feedback
- Perform effectively on interprofessional/interdisciplinary teams
- Formally document the iterative design process you used to address the identified need, develop a solution, iterate and test.
- Effectively pitch your proposed solution; communicate audience-appropriate health content both in writing and through oral presentation
- Apply the principles of iteration, collaboration, creative thinking, systems thinking, and teamwork in the problem-solving process.

- Learn basic use of engineering tools for device design and analysis.

Graduate (in addition to Undergraduate Outcomes)
- Apply the principles presented in the course to produce an individual work product relevant to your disciplinary field of study
- Provide leadership and peer mentoring to your team
- Propose strategies to identify stakeholders and build coalitions and partnerships in service of your proposed solution

Makeup Policy for Students Who Register Late: Students who register after the first class meeting may make up missed assignments/quizzes. The deadline for doing so will be determined on a case-by-case basis with the instructor.

Course Notes: D2L will be used to distribute the syllabus and any class notes, homework assignments, and readings.

Required Texts or Readings: *Biodesign: The Process of Innovating Medical Technologies* 2nd Edition. Yock, et al. Any additional required reading will be provided at least 48 hours prior to class.

Equipment and software requirements: For this class you will need daily access to the following hardware: laptop or web-enabled device with webcam and microphone; regular access to a reliable internet signal; ability to download and run the following software: web browser, Zoom, and Adobe Acrobat.

Remain flexible: If pandemic conditions warrant, the University may require that we return to remote operations. If that is the case, we will notify you by D2L Announcement and email that we are moving to remote operations.

Course Requirements: Your learning will be assessed in a number of ways in this course, including through reading quizzes, discussions, and oral presentations. Details and deadlines will be posted on D2L.
All work for this course will be submitted or completed online via D2L. You will be expected to attend each session and actively participate in activities and complete all assignments.

1. **Attendance and in-class participation**: Attendance and participation in in-class exercises are important aspects of learning the content in this course. In-class quizzes will be used to verify that you have participated in the in-class activities and to test your basic understanding of what you have learned.
2. **Assigned reading**: Please read assigned reading prior to class and complete any associated reading quizzes. Assigned reading will not be assessed directly, but rather will be assessed through assignments.
3. **Assignments**: Homework will be assigned to assist in understanding the course material. Assignments due dates will be posted on D2L. Written assignments are submitted through the Assignment tool in D2L. Details on assignments are included below.
4. **Group Final Project**: The group final report gives you an opportunity to apply the concepts presented in the course to an authentic healthcare challenge and to practice communicating audience-appropriate content through written media.
5. **Presentations:** The mid-semester and final presentation provide an opportunity to receive peer feedback and to practice communicating in oral and visual format.
6. **Individual Final Project (graduate students only)**: The individual final project gives you an opportunity to engage more deeply in the design process by expanding on some aspect of your group's work in a way that draws on skills and abilities relevant to your own area of graduate study to create a final product applicable to your discipline (e.g., conference short paper, case brief, grant proposal, business plan).

Grading Scale/Student Evaluation and Policies: Final grades are based on the following percentage grading scale:

Letter Grade	Percent
A	90%-100%
B	80%-89%
C	70%-79%
D	60%-69%
E	< 60%

Final course grades are not automatically adjusted or "rounded up." University policy regarding grades and grading systems is available at http://catalog.arizona.edu/policy/grades-and-grading-system

Late work: Submitting assignments late will incur a 10% penalty if less than 24 hours late, a 25% penalty if submitted between 1 and 7 days late, and not accepted if submitted more than 7 days late unless discussed with the instructor prior to assignment deadline or in the event of an emergency interfering with the student's ability to complete their work. Requests for additional time will be evaluated on a case-by-case basis. When extenuating circumstances dictate, we reserve the right to modify this policy.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal, respectively.

Dispute of Grade Policy: Grades on graded deliverables must be disputed within one week of the grade being issued.

Code of Academic Integrity: You are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. You are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/codeofacademicintegrity and http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

The University Libraries have some excellent tips for avoiding plagiarism, available at http://new.library.arizona.edu/research/citing/plagiarism.

Required examinations, papers and projects: The assessments listed below contribute to the final grade a follows:

All assignments are due at 11:59pm via D2L on the day listed below. Presentations are conducted during class time. The Final exam/project schedule and regulations can be found here: https://registrar.arizona.edu/finals

Assessment Methods (#)	Due Dates	Undergraduate Points	Graduate Points
Attendance and In-class Participation	Daily during class times	15%	15%
Assignment 1: Needs Finding	Thursday, 2/3	8%	8%
Assignment 2: Needs Screening	Thursday 2/17	8%	8%
Assignment 3: Concept Generation and Selection	Thursday 3/17	8%	8%
Mid-Semester Presentation	Tuesday 3/1, Thursday 3/3 1:00 pm – 3:00 pm each day	15%	15%

Rev. 01/01/22

Assignment 4: Concept Exploration, Testing, and Final Concept Selection	Thursday 4/14	8%	8%
Assignment 5: Verification and Integration	Thursday 4/28	8%	8%
Group Final Report	Tuesday 5/10	15%	10%
Group Project Presentation	Finals day	15%	10%
Individual Final Report Proposal (graduate students)	Thursday, 3/24	--	2%
Individual Final Report (graduate students)	Tuesday 5/10	---	8%

Description of each Assessment and Competencies Covered by the Assessment

Attendance and In-Class Participation: Students will be expected to attend all class sessions and participate in activities and discussions. Attendance is measured by participation quiz in the middle of the lecture, and participation in in-class discussions. 90% attendance is required to receive full points for this assessment. Excused absences (health, participation in academic meeting, etc) will not count against this.

Assignment 1: Needs finding. The first assignment will be based on identifying a need in the health sector through interviews, shadowing, and research, and analyzing the potential of a solution. The assignment will include a description of experiential activities to interface with healthcare professionals along with identified needs and self-directed research to generate market analyses and potential barriers translation. Needs statements will be written for the identified needs, which will serve as the basis for Assignment 2. The assignment will be submitted in report format. The group can write the report as a group but each student must submit individually.

Assignment 2: Needs Screening. The second assignment aims to assess the feasibility and potential for innovation of each need identified in Assignment 1. In this assignment, you will perform a disease state analysis, identify existing solutions, and ultimately perform needs selection by generating selection factors and assigning scores for each of your needs. The assignment will be submitted in report format and can be included as subsequent sections in the report of Assignment 1. The group can write the report as a group but each student must submit individually.

Assignment 3: Concept Generation and Selection. The fourth assignment will assess a student's understanding of concept generation and selection, including activities to conduct the process for the group's project. This includes planning and executing an ideation session, documenting the output and then clustering and mapping ideas to select a small subset of concepts to explore in more detail The assignment will be submitted in report format and can be included as subsequent sections in the ongoing report. The report includes the description of the ceoncept generation and selection process, as well as output of concept clutering and mapping. The team can write the report as a group and include it as additional sections to the ongoing report, but each student must complete the individual questions and submit a copy of the report.

Mid-Project Presentation. The mid-project presentation will be delivered to the class prior to spring break, and peer / instruction feedback will be provided both on technical content and on delivery / organization. This assignment will assess a student's practical implementation of the topics in first three modules: needs finding, needs screening, and concept generation, as well as oral and visual communication skills. A portion of credit (5% of the 13%) for this assignment will be awarded for completing the peer feedback.

Assignment 4: Concept Exploration, Testing, and Final Concept Selection The fifth assignment will assess a student's understanding of concept exploration (prototyping), testing and final concept selection. For the concepts selected in Assignment 3, the group will perform a functional decomposition and identify the primary

questions to be addressed through prototyping. The group will build a model and then test and refine the model to develop design requirements and technical specifications. At the end of this Assignment, the group will have ranked concepts based on requirements and specifications, and selected a final concept for further development. The assignment will be submitted in report format. The team can write the report as a group and include it as additional sections to the ongoing report, but each student must complete the individual questions and submit a copy of the report.

Assignment 5: Verification and Integration. The final assignment assesses the student's understanding of verification and also the process of integrating a new device into practice. This assignment will include developing a testing & verification plan for the team's device. The assignment also will include an assessment of the barriers to technology translation, different avenues of commercialization, and developing a commercialization plan for the team's device. The team can write the reports as a group and include it in the final report, but each student must complete the individual questions and submit a copy of the reports.

Group Project Presentation: The final presentation will be delivered on the designated Finals day. This assignment will assess the student and team's ability to apply the concept of design thinking to device design. Assessment will focus on the application of these concepts, not the performance of the final result (e.g, performance of the designed device). Assessment of the delivery and organization of the presentation, and communication skills will also be included.

Group Final Report: The group final report will assess the student and team's ability to synthesize the modules and practically apply them to design, prototype, and test a device for improving healthcare. The report should include an overview section with a description of how each module was applied to their device development, and the results. The majority of the final report will be composed of the reports generated for assignments 1,2,3,4 and 5 (with revisions as needed). Written communication skills will be assessed.

Individual Final Report and Proposal: The individual final report is a graduate-only assignment and is meant to enable students to apply the concepts learned in the course to a discipline-specific problem or task. This could take the form of a literature search for needs identification, a grant proposal, writing a business plan, etc. The student should select a potential topic and propose it in a short 250-word abstract, which will be approved by the instructor.

Required extracurricular activities: Students are expected to interface directly with healthcare professionals during the Needs Finding and Integration modules. This may include visits to the healthcare professional's place of work, interfacing with patients, shadowing individuals, etc. This is expected to take be included in the anticipated "out of class" time expectation.

Course grades and feedback are available for your review on D2L at all times. It is your responsibility to keep track of your academic progress throughout the course.

Final exam regulations and schedules are available at
https://www.registrar.arizona.edu/courses-catalog/final-examination-schedule-spring-2021

Course Schedule: Each meeting will consist of approximately 30 minutes of lecture-style learning, with the following 90 minutes for in-class assignments and group work. See attached class schedule.

Communications: Online communication will occur using the Announcement feature of D2L and the official UA email system, when appropriate. You are responsible for reading emails sent to your UA account from your instructors and the announcements that are placed on the course web site. Information about readings, news events, your grades, assignments and other course related topics will be communicated to you with these

electronic methods. The official policy can be found at: https://www.registrar.arizona.edu/personal-information/official-student-email-policy-use-email-official-correspondence-students

Class Recordings: For lecture recordings, which will be provided for all scheduled class meetings, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with UArizona values and educational policies are subject to suspension or civil action.

Classroom Behavior Policy: To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

UA Smoking and Tobacco Policy: The purpose of this Policy is to establish the University of Arizona's (University) commitment to protect the health of University faculty, staff, students, and visitors on campuses and in its vehicles. The official policy can be found at: http://policy.arizona.edu/ethics-and-conduct/smoking-and-tobacco-policy

University Course Policies: (please see the following URL for university-wide policies on absence and class participation, threatening behavior, accessibility and accommodations, and nondiscrimination and anti-harassment):
https://academicaffairs.arizona.edu/syllabus-policies

Gender Pronouns: It is already UArizona policy that class rosters are provided to instructors with a student's preferred name. You may share your preferred name and pronoun with members of the teaching staff and fellow students, as desired, and these gender identities and gender expressions will be honored in this course. Because the course includes group work and in-class discussion, it is critical to create an educational environment of inclusion and mutual respect. In this class, to be inclusive of all gender identities and expressions, you will be referred to by your first or last name, the pronoun of your choice, or by default, the pronoun "they".

Subject to Change: Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructors.