

# CE 499: SPECIAL TOPICS: INNOVATION IN ENGINEERING DESIGN FOR GLOBAL CHALLENGES

*Fall 2018 (Part 1)*

*Thursdays, 8:00pm – 10:00pm, Classroom TBD*

## INSTRUCTORS:

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## COORDINATOR:

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## 1. COURSE DESCRIPTION

Today, there are numerous global crises that challenge the world and devastate populations, such as the refugee crisis with massive impact on higher education, economy, health and so on. Engineering innovation plays a critical role in solving many of the challenges brought about by these global crises. This course aims to teach engineering students how to lead the design of products, services and technologies with a human-centered approach to help solve the needs of the real people who are in the middle of these crises. The course is geared towards students who would like to create new solutions, are comfortable with focusing on wicked problems, and care about cultural, economic and geographic nuances. The course is built on the principles of “create, collaborate, innovate.” The course provides students with an understanding of the design process, research methodologies and innovation strategies using a team-based project work through the process of observation, visualization, rapid prototyping and iteration.

This course has two parts: Part 1 (Fall semester) and Part 2 (Spring semester). Over the course of one year, 24 contributors (12 USC students in Los Angeles and 12 refugees in a host nation) will form a taskforce to seek at least four life-saving or life-improving innovations aimed at the most vulnerable and hardest-to-reach people impacted by the refugee crisis. These innovations will involve connection to the private sector and input from affected communities in order to provide, supply, or locally generate solutions such as: safe drinking water and sanitation, provision of energy, education, life-saving information, shelter or services to help refugees living in camps and in squats.

## 2. LEARNING OBJECTIVES

Instructors will teach the students the process of product innovation, prototyping, fabrication and building sustainable business models in the initial stages of the course, then continue to mentor and guide teams as they are working on their projects. In this course, students will learn:

- The process of product/service development
- Design thinking and systems thinking approaches to development
- Identifying and validating a product need and use case via user research
- Prototyping concepts for user research and validation
- Building a Minimum Viable Product (MVP)
- Designing for manufacturing
- Understanding the product life-cycle
- Developing a sustainable business model

- Learning how to effectively use global collaboration tools and techniques
- Fundraising/crowdsourcing to fund product development
- Sourcing and managing prototyping and manufacturing vendors
- Rapid prototyping techniques and methods
- Building bill of materials
- Product distribution
- Entrepreneurship in restricted environments/lack of resources

### **3. METHODS OF TEACHING**

A combination of design feedback sessions, lectures, hands on software sessions, experiments with new technologies and discussions. Guest lecturers may also be brought in to provide specialized guidance on specific topics to one or all of the teams. Additional out of class time required for team-based project work, course assignments and reviewing relevant material. Teams are expected to meet and collaborate outside of class, both in person as well as virtually with their global team members. Each team will share their progress, prototypes, findings, and challenges with the entire class weekly, while instructors mentor the teams and help them solve the challenges they encounter at each stage of development. The rest of the class will also participate in helping teams define the need for their product and work through development challenges.

### **4. ATTENDANCE**

Continuous attendance is critical for success in this class in order to ensure that teams continue making progress on the development of their products. Attendance is part of the evaluation criteria. If a student misses a class, it is his/her responsibility to ask at the next class what he/she missed or find out about topics covered.

### **5. CLASS PARTICIPATION**

Participation in the class is part of the evaluation criteria. This is a highly interactive class. There is continuous interchange between the instructors, guest lecturers, students and refugees. Questions and participation in discussions are highly encouraged.

### **6. CLASS COMMUNICATION**

As teams will involve contributors outside USC without access to USC resources, teams will make use of free-to-use, globally available collaboration software including: Skype, Slack, Google Docs, Trello, Google hangouts and WhatsApp.

### **7. COURSE COORDINATOR**

Due to the special needs of this course, Mr. Daniel Druhora will act as the coordinator for this course. His role and responsibilities include handling administrative tasks, coordinating stakeholders, logistical planning for travel and communication. He could be reached at: [druhora@usc.edu](mailto:druhora@usc.edu)

### **8. OFFICE HOURS**

5pm to 7pm on Thursdays at KAP 224C. Instructors and the coordinator will also be available via email and course communication tools.

### **9. REQUIRED TRAVEL**

The course is offered at the UPC of USC. However, this course will involve travel to overseas locations. Specific travel dates and locations of the trip is noted below.

Part 1 Trip: Lesbos, Greece, Sept. 7 – 17, 2018

### **10. TEAM STRUCTURE**

The course will have 24 contributors (12 USC students in Los Angeles and 12 refugees in a host nation). 4 teams made up of 3 USC students and 3 refugees will be formed at the beginning of the semester.

## 11. ADDITIONAL RESOURCES

Due to the special nature of the course, several individuals/groups will also contribute to the class in addition to the instructors, course coordinator, students and refugees. These will include additional academic, industry/NGO advisors, as well as marketing and communication support. Student Clubs, such as Spark SC, Engineers Without Borders, will also provide support to the course.

## 12. RECOMMENDED READING

- Design of Everyday Things, Don Norman
- The Lean Startup, Eric Ries
- Engineering for sustainable human development: A guide to successful small-scale development projects, Bernard Amadei
- Ten Principles of Good Design, Dieter Rams
- Convivial Toolbox: Generative Research for the Front End of Design, Liz Sanders
- The Field Guide to Human-Centered Design, by IDEO.org, <http://www.designkit.org//resources/1>
- Designing for People, Henry Dreyfuss

## 13. ASSIGNMENTS

At the beginning of the course, teams will identify several project ideas out of a longer list developed by collaboration among students, refugees, instructors, refugee camp managers, NGOs and government organizations. Teams will immediately begin researching/validating the need, as well as brainstorming potential solutions. After further validation with their global team members, each team will down select to one idea to pursue. Teams are required to continue to get a deeper understanding of the problem and various potential solutions on a continuous basis. Each team will immerse themselves in the challenges of the refugee crisis and specific problem spaces, identify potential products, services or solutions that could meet a need, and begin to learn the product development process. They will also work with stakeholders to validate problems and user needs and begin prototyping solutions for testing and validation. Teams will continue iterating and improving on their products, including sending prototype to their global team members for real-world testing and evaluation. Teams will begin developing a plan for scaling product into a sustainable solution for refugees. Prototypes and scalability plans will be refined and revealed at a summit involving all team members and potential stakeholders.

→ **It is important to note** that each team will have a “Design Journal” in which they document their validation and decision process at every step, focusing on their processes. This Journal will be submitted with prototypes, reports, presentations as outlined in the assignments descriptions below. It is important to note that the grading will not be primarily based on solely on the success of the prototype, but on the development process, ability to learn from failure and adjust, and ability to work as a team both locally and with the global counterparts. Design journals will help the instructors to assess each team’s development process.

### **What is a Design Journal?**

A Design Journal is a notebook or log containing students’ drawings, reflections, decisions, and during the design and engineering processes. This is consistent with industry practice where such a notebook is used primarily for the benefit of the designer, to keep track of important ideas and data and to protect intellectual property. In the context of this course, a design journal is incorporated into instruction as a pedagogical tool and is used for assessment. The intent is to assess the student’s solution process separately from their design artifacts. Besides enhancing student learning through self-reflection, journals can simultaneously provide the instructor with unique insight into students’ mental processes and serve as a central location for students to collect and review problem scoping, brainstorming, notes, research, sketches, procedures, data from tests, detailed drawings and any other relevant information that led to design decisions.

**Part 1 Midterm Assignment:** Each team will identify the opportunity/need for the product by carefully studying their users and their needs. Based on this understanding, the teams will identify 3 product ideas and prepare SWOT analysis for each one of them by researching existing products/solutions and doing a competitive benchmarking of their product ideas to existing products/solutions. Each team will submit their design journals, a report summarizing 3 product ideas and the SWOT analysis and present their report in class.

**Part 1 Final Assignment:** At the end of Part 1, each team will define their product, prepare a validation spec sheet, built their prototypes and test them with real users/customers. At the end of the class, each team will submit their design journals, a short report summarizing their journey, their prototype, and present their prototype.

It is crucial that students turn in whatever they have on the due date. NO assignment will be accepted late. Assignments are due the beginning of the class as specified in the class schedule below. An incomplete grade will only be issued when a student is unable to complete the work because of documented illness. A letter from your physician will be required documentation.

**14. GRADING SCHEMA**

Class participation & discussion: 10%  
 Midterm assignment: 40%  
 Final assignment: 50%  
**TOTAL: 100%**

**15. CLASS STRUCTURE & SCHEDULE:**

\* Class sequence, dates topics and guest speakers are subject to change.

<b>PART 1: FALL SEMESTER</b>			
#	Date	Topics	Recommended TO DO List
1	8/23	<b>COURSE INTRODUCTION</b> Refugee Crisis Overview Team introductions	
2	8/30	<b>IDENTIFY THE OPPORTUNITY/ FINDING THE NEED</b> Immersion - understanding & empathizing with the user Learning customer routines, challenges, pain points Identify the specific problem or need	
3	9/6	<b>IDENTIFY THE OPPORTUNITY/ FINDING THE NEED</b> Immersion - understanding & empathizing with the user Learning customer routines, challenges, pain points Identify the specific problem or need	
4	9/13	Validating the need/Onsite User Research ( <a href="#">Trip to Lesbos, Greece. Dates: September 7-17, 2018</a> )	User Personas - ensure the team understands who they are designing for
5	9/20	<b>USER ARCHETYPES / USER JOURNEY</b> Understand the use case/define the user journey (how will the product be used)	User Journey - ensure the team understands the need and the context around it

		<p>User Archetypes</p> <ul style="list-style-type: none"> <li>- Who is the user? Who isn't the user?</li> <li>- What is their age? Gender? Where do they live?</li> <li>- What are the resources available to them?</li> <li>- Why do they need this product?</li> <li>- How will they discover it?</li> <li>- Where will they get one?</li> <li>- How will they use it?</li> <li>- How many potential customers are there?</li> </ul>	
6	9/27	<p><b>DEFINE THE USER JOURNEY</b>  Understanding the user goals and steps</p> <ul style="list-style-type: none"> <li>- What is hard for the user? Why?</li> </ul> <p>Intuitive design  Instructions  Product Issues/Maintenance</p> <ul style="list-style-type: none"> <li>- How could a user misuse the product?</li> </ul> <p>End of Life/Repair</p>	Brainstorming overview of all ideas/solutions
7	10/4	<p><b>IDEATION</b>  Product Brainstorming  Evaluate all ideas  Down selection</p>	2X2 Matrix of brainstorm ideas and how they were evaluated
8	10/11	<p><b>BENCHMARKING / RESEARCH</b>  Competitive benchmarking  Research existing products/solutions  SWOT analysis of product</p>	<i>Midterm due date</i>
9	10/18	<p><b>IDEA VALIDATION</b></p> <ul style="list-style-type: none"> <li>- How can we prove the need is real?</li> <li>- Why is this solution better than existing solutions?</li> </ul>	
10	10/25	<p><b>DEFINE THE PRODUCT</b>  List all essential features (Required but not high value)  List differentiating features (1-3 key features)  List all extra features (throw these away)</p>	Prototype validation spec sheet (what the purpose of the prototype is, what will be evaluated, how it will be evaluated, how the prototype should be used, what the findings were, what recommended next steps/next iteration are)
11	11/1	<p><b>DESIGN-PROTOTYPE-TEST-REFINE LOOP</b></p>	1st Prototype build
12	11/8	<p><b>PROTOTYPING / DESIGN ITERATION</b>  Building a prototype: define what you are building</p> <ul style="list-style-type: none"> <li>- What is the specific purpose?</li> <li>- What are you testing/investigating/validating?</li> <li>- How long will it last?</li> </ul>	MVP planning document: (what are the required/non-differentiating features, what are the key differentiating features, what are all other features (to be discarded for now))

13	11/15	Building a prototype: define what you are building - What is the specific purpose? - What are you testing/investigating/validating? - How long will it last?	
14	11/22	<b>THANKSGIVING BREAK</b>	
15	11/29	Project presentations/assessments	
	*	<b>BUILD MVP</b> (first prototype to test with real users/customers)	* <i>Final</i> is due on the schedule date of the final exam*

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

### Support Systems:

*Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call*

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. [engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

*National Suicide Prevention Lifeline – 1 (800) 273-8255*

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. [www.suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org)

*Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call*

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. [engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

*Sexual Assault Resource Center*

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: [sarc.usc.edu](http://sarc.usc.edu)

*Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086*

Works with faculty, staff, visitors, applicants, and students around issues of protected class. [equity.usc.edu](http://equity.usc.edu)

*Bias Assessment Response and Support*

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. [studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

*The Office of Disability Services and Programs*

Provides certification for students with disabilities and helps arrange relevant accommodations. [dsp.usc.edu](http://dsp.usc.edu)

*USC Support and Advocacy (USCSA) – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. [studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

*Diversity at USC*

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. [diversity.usc.edu](http://diversity.usc.edu)

*USC Emergency Information*

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. [emergency.usc.edu](http://emergency.usc.edu)

*USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.*  
Provides overall safety to USC community. [dps.usc.edu](http://dps.usc.edu)