

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

**Instructors**    **Coordinator**  
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*Units: 2*

*Fall 2019 Syllabus (Part 1)*

*Monday, 7:00pm – 8:50pm, KDC 241*

## 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 and students of other majors how to lead the design of products, services and technologies with a human-centered design 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 Design Thinking approach of “Discover, Define, Develop, Deliver,” and the lean startup methodology of “Build, Measure, Learn.” 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 2 semesters year, several contributors (students, people in need, for example, refugees, homeless, etc.) will form a taskforce to seek life-saving or life-improving innovations aimed at the most vulnerable and hardest-to-reach people impacted by the global grand challenges. 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 for helping the people in need.

**Part 1 Description:** At the beginning of the course, multidisciplinary teams will research the problem space and identify several potential project opportunities out of a longer list developed in collaboration with students, instructors, global partners, NGOs and government organizations. Teams will 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 global 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 their prototypes to their global team members for real-world testing and evaluation. Teams will then 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.

## 2. LEARNING OBJECTIVES

Instructors will teach the students the process of product innovation, prototyping, fabrication and building

sustainable business models, 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
- Lean Startup methodology and building a Minimum Viable Product (MVP)
- Designing for manufacturing
- Understanding 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
- Developing product/business pitches for projects.

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

This course operates with an approach similar to a startup incubator model - A combination of feedback sessions, lectures, experiments with new technologies and discussions. Significant additional out of class time is required for team-based project work, course assignments and reviewing relevant material. Teams are given an initial seed funds for fabrication of prototypes and 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 on a regular basis, while the 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. Guest lecturers may also be brought in to provide specialized guidance on specific topics to one or all of the teams.

### **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 global partners. 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

Instructors' Office Hours: TBD. Instructors will also be available via email and course communication tools.

## 9. REQUIRED TRAVEL

This course will involve travel to overseas locations, which will be announced at the beginning of the semester. At least one of these trips will include a visit to a site, such as refugee camp (e.g., in Greece). Note: not all students are guaranteed to travel each semester. Typically, one half of the students in class will travel in each semester. The students that do not make the trip in the fall semester will travel in the spring semester, if needed and possible.

## 10. 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 global partners. These will include additional academic, industry/NGO advisors, as well as marketing and communication support.

## 11. RECOMMENDED READING

- The Lean Startup, Eric Ries
- The Field Guide to Human-Centered Design, by IDEO.org, <http://www.designkit.org//resources/1>
- 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
- Designing for People, Henry Dreyfuss
- Business Model Generation: A handbook for Visionaries, Alexander Osterwalder
- The Lean Product Playbook, Dan Olsen

## 12. ASSIGNMENTS

**Weekly Assignments:** Please check the weekly schedule

**Midterm Assignment:** Each team will identify the opportunity/need for the product by carefully studying the users and their needs. Based on this understanding, the teams will identify 3 product ideas and prepare SWOT analysis, 2x2 matrix and weighted criteria scorecard evaluations, and competitive benchmarking against existing products/solutions for each of their ideas. Each team will submit a written report and present their report in class explaining the problem opportunities, as well as explaining their ideas and evaluation processes.

**Final Assignment:** Each team will define their product, prepare a product brief, validation spec sheet, build their prototypes and test them with real users/customers. At the end of the class, each team will submit a report summarizing their journey and present their project, MVP and next steps for semester 2.

**Note about presentations:** Midterm and final presentations will be team presentations; each team will use Power Point for their presentations and will have about 20 minutes. All other in-class presentations will be around 5-10 minutes depending on the topic; power point presentations are recommended but not required.

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 a physician will be required documentation.

**It is important to note** that each student will have a “Design Journal” in which they document their user research, brainstorming process, ideas, validation and decision process at every step, focusing on their processes. This journal will be submitted with reports, presentations, prototypes, etc. as outlined below.

**13. GRADING SCHEMA**

**Individual’s participation in class discussions: 10%**

**Weekly deliverables: 30%**

**Midterm: 20%**

Team report: 10%

Individual’s design journal: 6%

Peer evaluation for team work: 4%

**Final: 40%**

Final Product: 20%

Report: 10%

Individual’s design journal: 6%

Peer evaluation for team work: 4%

**TOTAL: 100%**

**14. GRADING CRITERIA**

It is important to note that the grading will not be primarily based on the ultimate success of the project, 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. Successful project teams will include both individuals who understand the unique context of the global challenge, and those who are capable of developing, testing, refining and transitioning to scale their innovation to produce transformative impact. Projects are expected to take an integrated innovation approach, defined as the coordinated application of scientific/ technological, social and business innovation, to develop solutions to complex global challenges. This approach does not discount the singular benefits of each of these innovations alone but highlights the powerful synergies that can be realized by aligning all three.

**15. CLASS STRUCTURE & SCHEDULE:**

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

<b>PART 1: FALL SEMESTER</b>			
#	Date	Topics	Weekly Assignments (Assignments are due the date they are listed)
1	8/26	<b>COURSE INTRODUCTION</b> Student/faculty/course introductions Global challenge overview  <b>OVERVIEW OF DESIGN THINKING &amp; INNOVATION</b> Discover, Define, Develop, Deliver Identifying the opportunity Finding the need	
2	9/2	<b>LABOR DAY --- No class (Surveys are due)</b>	
3	9/9	<b>DESIGN THINKING</b>  * Design Sprint	*Instructors will announce the teams
4	9/16	<b>USER PERSONAS / USER JOURNEY</b>	

		<p>Immersion – understanding &amp; empathizing with the user  Learning customer routines, challenges, pain points  Defining the user journey (how the product will be used)</p> <ul style="list-style-type: none"> <li>- Who is 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? What is hard for the user? Why?</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> <p>*RESEARCH TECHNIQUES  Interviews  Observation  5 whys  Empathy map</p> <p>*Refugee Persona Introductions</p> <p>*User Journey Workshop</p>	
5	9/23	<p><b>SYSTEMS THINKING</b>  Mapping stakeholder relationships</p> <p>*Systems Thinking Workshop</p> <p><b>PROBLEM SELECTION PROCESS  FINDING THE RIGHT PROBLEM</b>  What is the problem?  Is it the right problem?  How can we prove the need is real?</p>	<p><u>User journey submissions</u> –the need and the context around it</p> <p><u>User personas submission</u> – who is the design for</p>
6	9/30	<p><b>IDEATION TECHNIQUES</b>  Product Brainstorming  Brainstorming techniques  “How might we?”  Idea Generation techniques  Down selection into themes  Evaluate all ideas</p> <p><b>IDEA VALIDATION:  BENCHMARKING / RESEARCH</b>  Competitive benchmarking  Research existing products/solutions  SWOT analysis of product  Why is this solution better than existing solutions?</p>	<p><u>Presentation of 1-2 problems of interest by teams ((5 minutes)</u></p> <p><u>Mind map of crisis stakeholders &amp; relationships</u></p> <p><u>User journey map (related to team-selected problems)</u></p>

		2X2 Matrix: competitive products Weighted Criteria Scorecard	
7	10/7	<b>MIDTERM PRESENTATIONS</b>	<i>Midterm due</i>
8	10/14	TRIP for Validating the need/Onsite User Research/System mapping  <b>In class @LA:</b> Reflections from the team members who are on-site	
9	10/21	<b>DEBRIEFING</b> Open conversation about impressions from our trip & Q&A  How did the trip change your problem/idea?	<u>Brainstorming overview of all ideas/solutions based on lessons learned in the trip</u>  <u>Weekly team deliverables until midterm</u>
10	10/28	<b>DIFFERENT PROTOTYPE TYPES</b>  <b>CREATING A PRODUCT BRIEF</b> <b>DEFINING THE MVP</b> List all essential features (Required but not high value) List differentiating features (1-3 key features) List all extra features (throw these away)	<u>Sketch prototypes</u>  <u>Weekly team deliverables until final</u>
11	11/4	<b>DESIGN-PROTOTYPE-TEST-REFINE LOOP</b>  Building a prototype: define what you are building <ul style="list-style-type: none"> <li>• What is the specific purpose?</li> <li>• What are you testing /investigating/validating?</li> </ul> How long will it last?	* 1st Prototype build  <u>Sketches, physical &amp; digital prototypes</u>
12	11/11	<b>PROTOTYPING / DESIGN ITERATION</b>	<u>Sketches, physical &amp; digital prototypes</u>
13	11/18	<b>PROTOTYPING / DESIGN ITERATION</b>	<u>Sketches, physical &amp; digital prototypes</u>  <u>Practice pitch presentation (10 minutes)</u>
14	11/25	<b>PROTOTYPING / DESIGN ITERATION</b>	<u>Sketches, physical &amp; digital prototypes</u>

			<u>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))</u>  Practice pitch presentation (10 minutes)
15	12/2	FINAL PROJECT PRESENTATIONS	
	*	<b>BUILD MVP (first prototype to test with real users/customers)</b>	<b>*Final is due on the schedule date of the final exam*</b>

## 16. ACADEMIC RESPONSIBILITIES

### Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. Your letter must be specific as to the nature of any accommodations granted. DSP is located in STU 301 and is open 8:30 am to 5:30 pm, Monday through Friday. The telephone number for DSP is (213) 740-0776.

### Academic Integrity

The University, as an instrument of learning, is predicated on the existence of an environment of integrity. As members of the academic community, faculty, students, and administrative officials share the responsibility for maintaining this environment. Faculties have the primary responsibility for establishing and maintaining an atmosphere and attitude of academic integrity such that the enterprise may flourish in an open and honest way. Students share this responsibility for maintaining standards of academic performance and classroom behavior conducive to the learning process. Administrative officials are responsible for the establishment and maintenance of procedures to support and enforce those academic standards. Thus, the entire University community bears the responsibility for maintaining an environment of integrity and for taking appropriate action to sanction individuals involved in any violation. When there is a clear indication that such individuals are unwilling or unable to support these standards, they should not be allowed to remain in the University." (Faculty Handbook, 1994:20)

Academic dishonesty includes: (Faculty Handbook, 1994: 21-22)

1. **Examination behavior** – any use of external assistance during an examination shall be considered academically dishonest unless expressly permitted by the teacher.
2. **Fabrication** – any intentional falsification or invention of data or citation in an academic exercise will be considered a violation of academic integrity.
3. **Plagiarism** – the appropriation and subsequent passing off of another’s ideas or words as one’s own. If the words or ideas of another are used, acknowledgment of the original source must be made through recognized referencing practices.
4. **Other Types of Academic Dishonesty** – submitting a paper written by or obtained from another, using a paper or essay in more than one class without the teacher’s express permission, obtaining a copy of an examination in advance without the knowledge and consent of the teacher, changing academic records outside of normal procedures and/or petitions, using another person to complete homework assignments or take-home exams without the knowledge or consent of the teacher.

The use of unauthorized material, communication with fellow students for course assignments, or during a mid-term examination, attempting to benefit from work of another student, past or present and similar

behavior that defeats the intent of an assignment or mid-term examination, is unacceptable to the University. It is often difficult to distinguish between a culpable act and inadvertent behavior resulting from the nervous tensions accompanying examinations. Where a clear violation has occurred, however, the instructor may disqualify the student's work as unacceptable and assign a failing mark on the paper.

**Return of Course Assignments**

Returned paperwork, unclaimed by a student, will be discarded after a year and hence, will not be available should a grade appeal be pursued following receipt of his/her grade.



## 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” <https://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. <https://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. <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. <https://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: <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. <https://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. <https://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. <http://dsp.usc.edu>

*Student Support and Advocacy – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://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. <https://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, <http://emergency.usc.edu>

*USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.*

Provides overall safety to USC community. <http://dps.usc.edu>