Engineering Sustainable Design and the Global Community  
CEE 315/PPS 211/ENV 365 – Spring 2017

Design and testing of solutions to complex interdisciplinary design projects in a service-learning context. Technical design principles; sustainable and engineering best practices; prototype formation, testing and evaluation; and establishment of research and analysis methodologies in a community based research experience. Working in partnership with a community agency (local, national, or international), and participation in an experiential learning process by engineering a designed solution for an identified community need. Evaluation focused on design deliverables, fabricated prototypes and a critical reflection of the experiential learning process. One credit.

Pre-requisites: ECE 110L – Fundamentals of Electrical or Computer Engineering, OR  
EGR 201L – Mechanics of Solids, OR  
EGR 224L – Electrical Fundamentals of Mechatronics, OR  
CEE 301L – Fluid Mechanics, OR  
ME 336L – Fluid Mechanics, OR  
Consent of Instructor

Meeting times:  
- Wednesday and Friday, 11:45am-1:00pm  
- Each team must meet with instructor on a weekly basis at a mutually convenient time for assistance/clarification/direction and project updates

Location: Hudson 218

Course instructor:  
D. Schaad (dschaad@duke.edu); Office: 126 Hudson Hall; Phone: (919) 660-5174

Grading:  
Design Tasks  
Literature Review and P3 Proposal: 5%  
Conceptual Design: 5%  
Preliminary Design: 10%  
Final Design (and Prototype Demonstration): 20%  
Final Presentation: 5%  
Group/Peer Evaluations: 5%  
Team Meeting Attendance 5%

Critical Reflections of Learning Process  
Food and Water Reflection 5%  
Transportation and Mobility Reflection 5%  
Energy and Resource Consumption Reflection 5%  
Discussion Facilitation (and Participation): 5%  
Debate Preparation/Performance/Participation 10% (5% for each debate [x2])  
Quiz 1 7.5%  
Quiz 2 7.5%

Book OR Movie Discussions  
Option 1: Four times during the semester, student teams will be required to lead a discussion about a movie which examines the social implications of engineering OR cultural aspects of development OR some other relevant topic. Student teams will be responsible for leading a discussion about the movie discussing salient aspects covered in the film.  

OR

Option 2: Members of the class will propose a book to read related to the topic of sustainability, global development, etc. As a class we will vote on the selection and student teams will lead four in class discussions on the applicable issues identified in the book. Additionally, action items and implications toward engineering will be identified.
Text:
No texts are required for the design projects. Handouts/online readings will be provided for class.

Possible Projects:

International Projects:
- Uganda Clinic Project (Building - Distributed Electrical System)
- Madagascar Water Project
- Uganda Bridge Project
- Honduras Water Project

Domestic Projects:
- Ellerbee Creek Trash Strainer
- Durham (Hudson Hall?) Green Roof Project
- Oklahoma Tornado Shelter Project
- Town of Franklinville: Bridge Over Sandy Creek
- Town of Franklinville: Riverside Park
- Eno River State Park – Historic Home Preservation

Other student initiated ideas?

Tentative Schedule

January 13: Class Overview and Discussion of Possible Projects
Design Exercises

January 18: Communication Exercises
Community Based Research and Service Learning
Conducting Literature Searches
Current State of the Art/Practice

January 20: Product Development
Evaluation of Options
Conceptual Design Process
DUE: Form Project Teams

January 25: Introduction to Food and Water

January 27: Food: Nutrition, Malnourishment and the Original “Green Revolution”
DUE: Literature Review and P3 Proposal

February 1: Water: Treatment, Distribution, Abundance and Scarcity

February 3: What is Poverty and Who are the “Poor”?
Marketing to the “Bottom Billion”
Constructability and Sustainability
Tragedy of the Commons

February 8: Social Impacts of Engineering Design
Ethics and Social Implications

February 10: DUE: Conceptual Design (and Presentations)

February 15: Introduction to Transportation and Mobility
DUE: Food and Water Reflection
February 17: Urban Planning, Sprawl and Unintended Consequences
February 22: Social Mobility, Glass Ceilings, and How Do We “Move”?
February 24: Technical and Economic Evaluation
              Life Cycle Analysis
              Triple Bottom Line
March 1:     *Movie/Book Discussions #1 & #2*
March 3:     Research and Testing Methodologies
              Failure Evaluation
              Project Management and Critical Paths
              Project Delivery and Documentation
              Field-scale Implementation and Management Issues
March 8:     *DUE: Preliminary Design (and Presentations)*
              *DUE: Quiz 1 – Income Inequality, Food, Water, Mobility*
March 10:    *Preliminary Design Presentations* (Continued)
              *DUE: Transportation and Mobility Reflection*

**SPRING BREAK**

March 22:    Introduction to Energy and Resource Consumption
March 29:    Resources, Commodities, and Consumerism
March 31:    Sustainability in Operation and Maintenance
              Design Longevity
              Emerging Issues in Sustainable Design
April 5:     *Movie/Book Discussions #3 & #4*
April 7:     Social Entrepreneurship
              Financing, Market Diffusion, and Fiscal Sustainability
April 12, 14, 19, and 21:  
              *Student Debates:* Immigration; Income Inequality; Development Aid; Energy Policy, Subsidies, and Resource Consumption
              *DUE: Energy and Resource Consumption Reflection* (April 14)
April 26:    Course Wrap-up
              *DUE: Quiz 2 – Energy and Other Issues*

**Finals Week:**  
              *DUE: Final Project Presentation (and Prototype Demonstration – if appropriate)*