CRSN 151A: Sustainability Praxis in the Built Environment (5 units)

The goal of this 5 unit class is to introduce students to the concepts, methods, practices and “tools of the trade” for conceptualizing and conducting research into sustainability praxis in the built environment, and to the quantitative and analytical tools required to conduct such analysis and research. The focus of class is on (i) learning how to analyze complex and “wicked” problems and issues; and (ii) applying this skill to understanding how energy, water, food, raw materials and waste flow through the human-built environment, with a particular concern for systemic and infrastructural relationships and how these manifest in those problems; (iii) learning how to prepare a sustainability policy analysis study; and (iv) identifying sustainability projects and the need for them. Students learn basic techniques and tools for estimating resource flows. They conduct initial surveys and assessments, perform building energy and resource auditing, learn the essentials of how to size, install, operate, and monitor energy and water supply, understand resource usage and distribution patterns. They will participate in longitudinal research regarding best-practice intensive and urban agroecology, energy monitoring and research interviews, and green building construction.

Course Objectives
1. Understanding of the basic aspects of resource flows in the built environment, and an ability to conduct basic assessments and quantification of these flows;

2. Introduction to social science aspects of human behavior, habits and practices where resource use is concerned and basic understanding of survey design and implementation;

3. Developing the skills required to specify, organize, and conduct research projects under faculty supervision, design, install and maintain monitoring equipment for ongoing sustainable systems research, and understand and analyze data;

4. Understanding and application of the analytical tools and concepts required to perform accurate assessments and quantification of sustainable systems in the human-built environment;

5. Application of statistical methods to develop and implement surveys and interviews around sustainability issues;

Course Requirements
Student work includes group and individual policy problem analysis, weekly problem sets, conduct of field assessments and research, data logging and analysis, initial development of an individual project and hands-on development of sustainable systems on one of several group projects in the field. Students will present their work in class during finals period. A research policy analysis paper is due in lieu of a final exam. There will be 3 hours of
class, 2 hours of fieldwork (to be scheduled) and about 10 hours of homework every week.

Course grading rubric
Attendance & participation: 5%
Group policy papers: 20%
Fieldwork: 20%
Individual project assignments: 20%
Final paper: 25%
Group presentation: 10%

Reading:
Readings are available on the internet or course web site.

Essential supplementary texts
Ellen van Bueren, et al (eds.), *Sustainable Urban Environments—An Ecosystem Approach* (Pringer), at:
Thomas Theis & Jonathan Tomkin, *Sustainability: A Comprehensive Foundation* (Connexions), at:

Class schedule & readings

Week 1: Introduction to the course

Meeting #1: Complex & “wicked” problems in sustainability & policy
Required reading:

Meeting #2: Problem analogies in the built environment

Required reading:
D. Gentner, “Generative models as mental analogies” (1981), at: https://ecommons.ucsc.edu/x/40jkrS; “Water-Circuit Analogy,” http://hyperphysics.phy-astr.gsu.edu/hbase/electric/watcirm.html
Assignment #1 (see detailed prompt at: https://ecommons.ucsc.edu/x/kivzts)
You are a transportation intern for CalTrans, working on the solution to traffic congestion on Highway 1 through Santa Cruz. Please prepare a group report laying out options (including calculations & costs) for solving this problem.

Week 2: Designing your project & policy analysis

Meeting #1: Project considerations-- Designing, organizing, completing and reporting.


Meeting #2: Identifying an issue for your individual policy analysis paper
Sustainable Santa Santa Cruz County Plan, October 2014, Part I (https://ecommons.ucsc.edu/x/PyDSBt) and Part 2 (https://ecommons.ucsc.edu/x/Ypy8kE)

Additional resources:
Assignment #2 (see detailed prompt at: https://ecommons.ucsc.edu/x/j0TgAR): For this assignment, you are required to prepare a 500 word abstract of a specific sustainability issue of relevance to Santa Cruz and compile a bibliography of no fewer than five sources you will use in preparing your paper. Please do not simply list likely-looking sources; be sure you skim them, at a minimum, to make sure they are relevant. Do not wait until week 7 to return to research on your issue; you should be collecting materials, conducting interviews (if appropriate), doing calculations and estimates, and drafting sections.

Week 3: Evaluating complex sustainability problem strategies & solutions

Meeting #1: Basic problem solving-skills and estimation techniques

Required reading:

Meeting #2: Stocks, flows & rectangles

Required reading:

Additional resources:
Assignment #3 (see detailed prompt at: https://ecommons.ucsc.edu/x/h8CxE1). This week, you are working in the Resource Recovery Department of the city of Santa Cruz. Your task is to work on ways to reduce dumping at the city’s landfill on Dimeo Lane, which is likely to be full by 2040, even though a large fraction of the materials brought there are recycled (the diversion rate for Santa Cruz County as a whole is 75%). There is good reason to think, however, that the lifetime of the landfill can be extended if the city’s diversion rate can be increased even more. Your report should discuss how this goal can be achieved.

Week 4: Green & Social enterprise

Meeting #1 & 2: Applying the Business Model Canvas to your project

Required reading:

Additional reading

Assignment #4 (see detailed prompt at: https://ecommons.ucsc.edu/x/ob5eeY). You are being asked to fill in the BMC for your project and conduct interviews with no fewer than five clients/audience members for your project (these should not be people whom you have previously interviewed).
Week 5: Numbers and values in sustainability

Meeting #1: Counting things that count, rather than things that can be counted

Required reading:

Additional resources:

Meeting #2: What is sustainability worth? How much does it cost?

Required readings:
Discounting the Future, http://www.ejolt.org/2013/01/discounting-the-future/;

Additional resources:

Assignment #5: (see prompt at https://ecommons.ucsc.edu/x/L5264i):
UCSC has decided to install of solar PV carports on site. The campus has the choice of either paying for the system itself or arranging a leasing-
management system for which it would pay a fixed price for power. The University has signed an agreement with PG&E not to dump any excess electricity into the utility grid, but it is also committed to carbon neutrality by 2025. UCSC consumes about 55 million kWh per year and has a peak power demand of 5 kW. It also has its own cogeneration plant using a natural gas-fired turbine that needs to be operated in parallel with a solar system (for information, see http://mediafiles.ucsc.edu/ppc/OtherEnvdocs/Cogen/cogenfinalis.pdf). The cogen plant is also not allowed to feed electricity into the PG&E system. What is the optimal size for the solar installation? How much will power cost from the solar system? Does it make more sense to install the system or purchase carbon dioxide offsets? What would you recommend that UCSC do?

Week 6: Projects & Analyses redux

Meeting #1: Your sustainability project revisited

Required reading:

Additional resources:

Meeting #2: Your policy analysis paper revisited

Required reading:

Additional resources:
Assignment #6: For this assignment, you need to interview at least five more people who belong to or work for your potential partners (listed in the first box on the BMC). In these interviews, you need to determine whether the partner already provides some version of the good or service you proposed project is intended to deliver, or why the partner has not proceeded on this (for example, if your project is focused on composting food waste and you were to interview one of the people who works in Refuse & Recycling (http://recycling.ucsc.edu/), you would ask about what the campus currently does with food waste, what it plans to do in the future, how your project might fill a hole or need in existing programs, and whether R&R would be interested in working with you. Note that this is not about identifying client segments or audiences; it is about not reinventing the wheel and determining whether and where your project can make a contribution. You can find a partner interview template here (https://ecommons.ucsc.edu/x/qFyOFv). Please record (if possible) and transcribe, and upload your materials to your Drop Box.

Week 7: People & sustainability

Meeting #1: What is “social behavior” and why does it matter?


Meeting #2: Applied environmental & social justice in sustainability

Assignment #7: By now, you should have a pretty good handle on your policy issue and have collected the materials necessary to write it. You can find useful guidelines to writing such papers in the readings above. A template for your paper’s organization can be found on pp 7-9 of Luciana Herman, “Tips for

Week 8: Energy in the built environment

Meeting #1: What is energy, what does it do, how is it measured, how does it move through buildings?


Additional resources:
Brown, “Energy Accounting,”
Klaus, “Thermodynamics,”
Cengel, “Heat Transfer,”

Meeting #2: Working with design & modeling programs

There is no assignment for this week. Please work on your policy analysis paper and project interviews.

Week 9: Urban agriculture research design

Meeting #1: How much food?

Meeting #2: What do you need to find out?

Assignment #8: Please be sure all of your interviews are uploaded to your Drop Box. Write a 500 summary of your findings and conclusions regarding the need or demand for your project.

Week 10: Water, water everywhere, but not a drop to...

Meeting 1: Hydrology & hydrogeology on campus
Reading: UCSC Campus hydrology, https://ecommons.ucsc.edu/x/cgYYie;

“Where does your water come from?”
http://www.cityofsantacruz.com/departments/water/where-does-our-water-come-from
“Campus Water Reuse Study,”
https://ecommons.ucsc.edu/access/content/group/d743cc9d-d7d2-4955-9835-a8219feaff42/Week%2008%20-%20Water%20Resources%20part%201/CampusWaterReuseStudys.pdf

Meeting 2: Graywater system design & precipitation capture
Reading:


Final exam period: Students will give brief talks on projects and policy analysis papers.

Final Papers must be submitted via email by 6 PM on the Wednesday of Finals Week.