Systems Thinking for Sustainable Development

Syllabus

Course Number: EAS550; Strategy 566
Term: Winter 2023
Course Time: Monday & Wednesday 8:30am-10am
Location: Dana, 2024

Instructor: Carissa Knox
cbknox@umich.edu
Instructor Office Hours: Tuesday, 10-11 in Dana 1315G and by appointment

Graduate Student Instructor: Zhaoqianyi Ji
qianyijz@umich.edu
GSI Office Hours: Monday, 3:30-4:30 in GSI office and by appointment

Course Objectives:
(1) Students will develop critical skills in global systems thinking, with global defined as relating to the entire world, as well as embracing all considerations of complex systems.
(2) Students will develop skills in system dynamics modeling using Vensim software.
(3) Students will develop awareness in issues related to environmental and social change, as well as strategies for studying and addressing sustainability challenges.
(4) Students will deploy system analysis skills in a variety of applications.

Enrollment Qualifications:
Graduate students are eligible for this course, with enrollment preference given to SEAS and Ross students. There are no pre-requisites for this course.

Course Format:
This course will, in general, have one lecture and one lab per week. Lectures are designed to introduce students with model concepts and simulation processes. Lecture slides or notes will be uploaded to Canvas. Labs are designed for modeling and simulation practices with software (Vensim PLE). Lab instructions will be distributed during the lab sessions.

Technology Accessibility:
Vensim PLE is free software, you should not have to purchase anything for this course. We will be using Vensim primarily on personal laptops or computers. It is our goal that any student,
regardless of access to technology, will be able to equitably participate in this course. If you face any technological barriers, please contact the instructor so accommodations can be made.

Assignments:
There are three individual homework assignments and ten lab assignments. Each lab assignment is due by the beginning of the next class. Homework assignments need to be submitted through Canvas under each assignment. You may discuss problems and solution approaches with your peers, but work should ultimately be your own.

Resources & References:
- **Recommended**: Vensim online documentation, [https://vensim.com/docs/](https://vensim.com/docs/)

Grading:
15% - Class participation
15% - Individual homework (3 individual assignments)
30% - Labs (10 lab assignments)
40% - Group project (interim deliverables 10%, report 15%, presentation 10%, peer-evaluated participation 5%)

Class Policies:
- Course materials will be made available on Canvas.
- Late assignments will be accepted up to 72 hours past this deadline at a penalty of 20%. Assignments will not be accepted more than 72 hours after they are due, unless an extension is requested and granted. Please be proactive about requesting an extension! You will most likely be granted an extension if one is requested.
- Any disputes regarding graded material must be written and turned in with the original assignment within one week after it is returned to you.
- Attendance is expected. Particularly with lab-based courses, missing class sessions can impact your ability to complete labs and the final project. If you have the need to miss a class, contact the GSI and the instructor prior to the class so we can give you additional resources or otherwise help you keep up-to-date.
- The University of Michigan recognizes disability as an integral part of diversity and is committed to creating an inclusive and equitable educational environment for students with disabilities. Students who are experiencing a disability-related barrier should
contact Services for Students with Disabilities. Please let one of your instructors know if there are ways that we can accommodate your specific needs and make the course more accessible and equitable.

- Email policy: Questions about assignments should be directed to the GSI via email with [EAS550/STRAT566] in the subject, cc’ the instructor. Questions and associated answers may be shared with the entire class.

**Academic Honesty:**
Academic honesty is expected. Any violation of University of Michigan policy as described in the Rackham Academic and Professional Integrity Policy and Ross Community Values will not be tolerated and may result in a failing grade. It is expected that all assignments will be completed without consulting previous solutions. It is the responsibility of the student to be familiar with the terms of the academic honesty expectations.

**Student Well-Being:**
Students may experience stressors that can impact both their academic experience and their personal well-being. If you are experiencing concerns, seeking help is a courageous thing to do for yourself and those who care about you. If the source of your stressors is academic, please contact me so that we can find solutions together. We are deeply committed to your success and learning goals for this course. Please reach out with any concerns and we will work together to address them. For personal concerns, U-M offers many resources, some of which are listed at Resources for Student Well-being on the Well-being for U-M Students website. You can also search for additional resources on that website.
**Course Outline:** (subject to changes)

<table>
<thead>
<tr>
<th>Monday</th>
<th>Wednesday</th>
<th>Friday</th>
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<tbody>
<tr>
<td>Date:</td>
<td>Topic:</td>
<td>Due:</td>
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<tr>
<td>1</td>
<td>Winter Break</td>
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<td>2</td>
<td>9-Jan Lecture 2: Systems &amp; Modeling</td>
<td>4-Jan Lecture 1: Overview of the Course</td>
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<td>3</td>
<td>16-Jan MLK Day</td>
<td>11-Jan Lab 1: Systems Thinking</td>
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<td>5</td>
<td>30-Jan Lecture 5: Fuzzy Cognitive Mapping</td>
<td>25-Jan Lab 2: CLDs</td>
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<td>6</td>
<td>6-Feb Lecture 6: Stocks and Flows</td>
<td>1-Feb Lab 3: FCMs 3-Feb HW: Fukushima</td>
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<td>7</td>
<td>13-Feb Lecture 7: Nonlinearity</td>
<td>8-Feb Lab 4: Building Stock and Flow Diagrams</td>
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<td>8</td>
<td>20-Feb Proj.: Progress Presentations</td>
<td>20-Jan HW: Explore a System</td>
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<td>9</td>
<td>Spring Break</td>
<td>10-Mar Proj.: Nonlinearity</td>
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<tr>
<td>10</td>
<td>6-Mar Lecture 8: Equilibrium</td>
<td>8-Mar Lab 6: Modeling S-Shaped Growth</td>
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<td>11</td>
<td>13-Mar Lecture 9: Delays Ford, Chpt. 18 &amp; 19, Beer Game Handout</td>
<td>15-Mar Lab 7: Real Estate Construction</td>
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<td>12</td>
<td>20-Mar Lecture 10: Stochastic Modeling &amp; Sensitivity</td>
<td>17-Mar HW: Phone Sales</td>
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<td>14</td>
<td>3-Apr Lecture 12: Modeling &amp; Bias Hovmand, 2014</td>
<td>24-Mar Proj.: Delays</td>
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<td>15</td>
<td>10-Apr Lecture 13: Synthesis &amp; Reflection</td>
<td>5-Apr Lab 10: Balancing Stakeholder Priorities</td>
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<td>16</td>
<td>17-Apr Proj.: Final Presentations</td>
<td>7-Apr Proj.: Sensitivity Analysis</td>
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<td>17</td>
<td>24-Apr Proj.: Submit Report</td>
<td>19-Apr Study Break</td>
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**Extra:**

- HW: Fukushima
- HW: Phone Sales
- HW: Explore a System
- HW: Fukushima
- HW: Fukushima
- HW: Fukushima
- HW: Phone Sales

**Assignments:**

- Proj.: Group Matching
- Proj.: Dynamic Hypothesis & CLD
- Proj.: FCM & Scenario Testing
- Proj.: Final Presentations
- Proj.: Final Presentations
- Proj.: Sensitivity Analysis
- Proj.: Sensitivity Analysis
- Proj.: Sensitivity Analysis

**Spring Break:**

- Spring Break
- Spring Break

**Summer Break:**

- Summer Break
- Summer Break
Final Project Details:
The group project contributes 40% of the final grade, including these four components:

1. Presentations (10%)
Each group presents their project to the class twice, including a project topic proposal presentation and final presentation. All members of the group are expected to present. The presentation should include the following when applicable:
  - Title and name
  - Research question
  - Motivation, importance, and how it relates to this course
  - Methods and data
  - Results and implications
  - Conclusions

2. Interim deliverables (10%)
There will be five interim deliverables for the group project. Detailed instructions will be provided separately.

3. Project report (20%)
You project report should be no more than 10 pages and provide a complete, accurate description of the research motivation, research question, methods, data, results, and discussions. Include only KEY figures and tables in the report; no-essential text, figures, and tables that are useful for readers to understand can be included in the appendix which does not count for the page limit.

4. Peer Evaluation (5%)
Each team member will evaluate the participation and contributions of their other team members, as well as themselves. Peer evaluation will be based on contribution to ideas, project organization and execution, work on the model, presentation, and paper, quality of work, and overall participation in the project.