

## **System Analysis for Sustainable Design and Lifecycle Decisions**

ENV 6932 - Spec Prob in Env Engr

Credit hours: 3

### ***Class Periods:***

T | Period 2-3 (8:30 - 10:25 am)

R | Period 3 (9:35 - 10:25 am)

***Location:*** 98% Online & 2% in-person

***Academic Term:*** Fall 2020

### ***Instructor:***

Sara Behdad

[sarabehdad@ufl.edu](mailto:sarabehdad@ufl.edu)

(352) 294-7547

**Office Hours:** Thursday, 8th Period (3:00-3:50 pm) or by appointment [zoom link: TBD]

**Office Location:** 412 BLK Hall

***Teaching Assistant/Peer Mentor/Supervised Teaching Student:*** N/A

Please contact the instructor for any assistance.

### ***Course Description***

The course is designed for graduate students who are interested in furthering their knowledge in decision-making methods with applications in sustainable systems design and lifecycle engineering. The main goal of this course is to equip students with analytical tools and decision-making techniques needed for creating sustainable systems. The course educates students with several quantitative methods and further discusses practical aspects of sustainability engineering and encourage them to look at the systems around them more carefully and think about opportunities to improve, reuse, replacement and reduction of the environmental impacts of the processes, systems, and behaviors.

Various analytical topics, including System Dynamics Simulation, Multi-Attribute Utility Theory, Discrete Choice Analysis, Axiomatic Design, Robust System Design, and Life Cycle Assessment, will be discussed. In addition to analytical tools, the course covers different sustainability applications and challenges. The applications presented in this class are from the levels of the product life cycle, machine, and systems, as well as the overall supply chain perspective.

Further, the course discusses the principles of sustainable lifecycle engineering including (1) lower usage of materials and energy (2) substitution of non-renewable with renewable input materials (3) reduce unwanted outputs/waste (4) close the loop (convert outputs to inputs through recycling, recovery, reuse) (5) re-engineering the structure of the commerce through revised supply chain structure and introduction of product-service systems.

***Course Pre-Requisites / Co-Requisites:*** N/A

### ***Course Objectives***

After completion of this course, students will be able to:

- Utilize principles of sustainable lifecycle engineering
- Apply analytical tools in the design and analysis of sustainable systems
- Evaluate the performance of engineered systems using sustainability metrics
- Understand the role of technology in addressing sustainability challenges

## Materials and Supply Fees

No materials and supply fees.

## Required Textbooks and Software

No required textbooks.

## Recommended Materials

- Green Manufacturing: Fundamentals and Applications (Green Energy and Technology), David A. Dornfeld (Editor), Springer, 2013
- Decision-based Design: Integrating Consumer Preferences into Engineering Design, Chen, W., Hoyle, C. and Wassenaar, H-J., Springer, 2012.
- Business Dynamics, System Thinking and Modeling for a Complex World, Sterman, John, 2000.

## Course Schedule

Two types of topics will be covered: (1) analytical methods, and (2) applications in sustainable lifecycle engineering.

*Notes:* The schedule is tentative as the pace dictates. The HW and assignment dates may change with advance notice on Canvas.

**Note:** For the hybrid session of the course, the class on Tuesday, Sept 29<sup>th</sup>, will be in-person, and students are supposed to give a presentation of Reading Assignment 2 in class. Please read COVID related practices of the face-to-face sessions.

|           |   |
|-----------|---|
| Week 1-2: | Simulation Modeling; (Reading Assignment 1)   |
| Week 3:   | Axiomatic Design; (HW1 term paper)  |
| Week 4:   | Design Structure Matrix, Quality Function Deployment; (HW2 Individual)                    |
| Week 5:   | Statistical Methods and Robust System Design; (Reading Assignment 2)                      |
| Week 6-7: | Decision Analysis and Multiattribute Utility Theory; (HW3 term paper)                     |
| Week 8:   | Consumer Preference Modeling; (HW4 Individual)  |
| Week 9:   | Life Cycle Assessment Methods; (HW5 term paper)   |
| Week 10:  | Principles of Sustainability; (Reading Assignment 3)                                      |
| Week 11:  | Design for Reuse, Remanufacturing, Repair and Recycle; (HW6 Individual)                   |
| Week 12:  | Artificial Intelligence and Circular Economy; Exam Review, Exam                           |
| Week 13:  | Sustainability and Smart Cities; Thanksgiving break (HW7 term paper)                      |
| Week 14:  | Rethinking of Technology, Intelligent Assets, Blockchain; (Reading Assignment 4)          |
| Week 14:  | Green Supply Chain; Packaging: A Look at Transportation;                                  |
| Week 15:  | Closed-loop Production and Green Energy Supply; Term paper presentations (HW8 term paper) |

## Evaluation of Grades

| Assignment  | Total Points | Percentage of Final Grade |
|---|--------------|---------------------------|
| Individual Homework Assignments (3)                 | 100 each     | 15%                       |
| Reading Assignments (4-5)                           | 100 each     | 15%                       |
| Exam  | 100          | 10%                       |
| Term Paper Assignments for a team of 3 students (5) | 100 each     | 50%                       |
| Term Paper Presentation                             | 100          | 5%                        |
| Class Participation                                 | -            | 5%                        |
|   |              | 100%                      |

## Grading Policy

| Percent     | Grade | Grade Points |
|-------------|-------|--------------|
| 95.0 - 100  | A     | 4.00         |
| 90.0 - 94.9 | A-    | 3.67         |
| 85.0 - 89.9 | B+    | 3.33         |
| 80.0 - 84.9 | B     | 3.00         |
| 75.0 - 79.9 | B-    | 2.67         |
| 70.0 - 74.9 | C+    | 2.33         |
| 65.0 - 69.9 | C     | 2.00         |
| 60.0 - 64.9 | C-    | 1.67         |
| 55.0 - 59.9 | D+    | 1.33         |
| 50.0 - 54.9 | D     | 1.00         |
| 45.0 - 49.9 | D-    | 0.67         |
| 0 - 44.9    | E     | 0.00         |

More information on UF grading policy may be found at:  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### Term Paper Specifications/policies

A team of 3 students will work on each term paper.

Each team paper should have an original contribution.

The term paper should include the following sections: (1) problem definition (2) literature review (3) Method (4) Method Evaluation/Application (5) Results and Conclusion

Each paper should include a literature review of at least 20 prior studies.

Each paper should include a section describing the problem definition and a section describing the method suggested for solving that problem.

An ideal paper should be an integration of both method development and application.

Term paper page limit: 8-12 pages

Team members will evaluate themselves during the semester, and your grade is a function of your team members' evaluation

The followings are some suggested areas that your paper can belong to:

- *Metrics for Green Manufacturing*
- *Energy and Waste Management*
- *Green Transportation*
- *Life-Cycle Decision Making*
- *Closed-Loop Supply Chain*
- *Design for End of Life Recovery*
- *Product-Service Systems*
- *Thermal and Energy Systems*
- *Life Cycle Assessment*
- *Reuse, Remanufacture, Recycle, Repair, Recondition, Reduce*
- *Remarketing of Refurbished Products*
- *Sustainable Design: Methods and Applications*

### Term Paper Deadline (tentative)

The first draft of papers (including literature review and the model development) are due on Thursday, October 29th (tentative).

Final papers (including results and design application) are due on Thursday, December 3rd.

Term-paper Presentations: The last week of classes.

## **Individual Homework Assignment Policies**

- One individual homework assignment every three or four weeks, total 3 assignments in the semester. They are typically assigned on Tuesday and due the following Tuesday.
- The homework assignments will be posted on CANVAS, and they are due before the next lecture starts the following week.
- Individual work
- Late assignments are not accepted—one letter grade per day late.
- Requests for correcting possible grading errors must be submitted to the instructor within one week after the work is returned with a written explanation of the correction request; no corrections are possible afterward.
- The tentative schedule for the exam is Thursday, Nov 19, 2020.
- Acknowledge all resources used. Plagiarism is not acceptable. Identical homework submission (applied to individual homework assignments, not paper) receive zero. You should protect your own work, including individual assignments, term paper, and exam all the time.

## ***Attendance Policy, Class Expectations, and Make-Up Policy***

Attendance is required, and it will be monitored through in-class activities and discussions. Attendance covers 5% of the final grade. You are permitted two absences for the whole semester. Excused absences must be in compliance with university policies in the Graduate Catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation and advance notice to the instructor. To schedule a make-up for an excused, missed assignments, please contact the instructor through email. Requirements for make-up assignments are consistent with the university policies.

## ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

## ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

## ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are

obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

### ***Privacy related issues for online course:***

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

### ***COVID related practices for face to face session:***

We will have face-to-face instructional sessions to accomplish the student learning objectives of this course. In response to COVID-19, the following policies and requirements are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- You are required to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.

- This course has been assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations.
- Sanitizing supplies are available in the classroom if you wish to wipe down your desks prior to sitting down and at the end of the class.
- Follow your instructor's guidance on how to enter and exit the classroom. Practice physical distancing to the extent possible when entering and exiting the classroom.
- If you are experiencing COVID-19 symptoms ([Click here for guidance from the CDC on symptoms of coronavirus](#)), please use the UF Health screening system and follow the instructions on whether you are able to attend class. [Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms](#).
  - Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. [Find more information in the university attendance policies](#).

***Campus Resources:***

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## Health and Wellness

### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

## Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.