EnE 465: Sustainable Environmental Infrastructure

(3 credits)

Lectures Mondays, 6:00 PM – 8:50 PM
GITC 2315A

Instructor William Pennock, Ph.D.
Colton Hall 268
whp3@njit.edu
(973) 596-5859

Office Hours: Tuesdays & Wednesdays
11:30 AM–1:00 PM

Prerequisites Introduction to Environmental Engineering (EnE 262)

Required Textbooks

Main

Tang, W. Z., & Sillanpää, M. E. T. (2019). *Sustainable environmental engineering* (First edition). John Wiley & Sons. https://www.wiley.com/en-us/Sustainable+Environmental+Engineering-p-9781119085584
ISBN: 978-1-119-08563-8

Sustainability
Envision Guidance Manual

LCA
Matthews, H. S., Hendrickson, C. T., & Matthews, D. (2014). *Life Cycle Assessment: Quantitative Approaches for Decisions that Matter*. Open access textbook. https://www.lcatextbook.com

Sanitation
Lüthi, C., Panesar, A., Schütze, T., Norström, A., McConville, J., Parkinson, J., Saywell, D., & Ingle, R. (2011). *Sustainable sanitation in cities: A framework for action.* Sustainable Sanitation Alliance (SuSanA), International Forum on Urbanism (IFoU), Papiroz Publishing House. https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/1019

Solid Waste
Wong, J. W. C., Surampalli, R. Y., Zhang, T. C., Tyagi, R. D., & Selvam, A. (2016). Sustainable solid waste management. American Society of Civil Engineers. https://ascelibrary-org.libdb.njit.edu:8443/doi/book/10.1061/9780784414101

Suggested References

Life Cycle Analysis

Graedel, T. E., & Eckelman, M. J. (2023). *Industrial Ecology and Sustainability*. WORLD SCIENTIFIC. https://doi.org/10.1142/13447

Environmental Justice

Cole, L. W., & Foster, S. R. (2001). *From the ground up: Environmental racism and the rise of the environmental justice movement*. New York University Press.

Stormwater

Sarté, S. B. (2010). *Sustainable infrastructure guide: The guide to green engineering and design*. John Wiley & Sons.

Water & Wastewater

Chamberlain, J. F., & Sabatini, D. A. (Eds.). (2022). *Fundamentals of water security: Quantity, quality, and equity in a changing climate*. Wiley.

Ngo, H. H., Guo, W., Surampalli, R. Y., & Zhang, T. C. (2016). *Green technologies for sustainable water management*. American Society of Civil Engineers Environmental and Water Resources Institute (U.S.) Toxic, and Radioactive Waste Engineering Committee.

Weber-Shirk, M., Guzman, J., O'Connor, C., Pennock, W. H., Lion, L. W., Du, Y., Maisel, Z., Conneely, J., Doyle, A., McGrattan, S., & Wood, E. (2021). *The Physics of Water Treatment Design*. Open access textbook.

Brownfields

Ferber, U., Nathanail, P., Jackson, J., Górski, M., Krzywon, R., Drobiec, Ł., Petríková, D., & Finka, M. (2006). *Brownfields Handbook*. https://fast10.vsb.cz/lepob/index1/handbook_eng_screen.pdf

Resources

Access to a computer with OpenLCA installed will be helpful.

Course Description

Environmental engineering concerns itself with preserving and restoring the quality of water, air, and soil. This course will examine drinking water, stormwater, wastewater, solid waste, and soil remediation activities from the perspective of sustainability, highlighting proven approaches. Sustainability will be framed within the Envision certification and Life Cycle Analysis (LCA) approach, with consideration of environmental justice issues.

Course Objectives (General)

By the end of this course, the student will be able to:

1. Students will develop an understanding of sustainability that is informed by multiple definitions, including the Envision framework.
2. Students will analyze the underpinnings of life cycle analysis and how it informs decisions about sustainability.

3. Students will develop an awareness of environmental justice concepts and issues.
4. Students will gain an understanding of relevant infrastructure concepts and examples for multiple environmental infrastructure areas and be able to evaluate their advantages and disadvantages.
5. Students will study a sustainable infrastructure choice in depth, referencing academic and non-academic literature to create a research report and presentation on a sustainable infrastructure solution of their choosing.

POLICIES & PROCEDURES

Academic Integrity:

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. ***Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.*** *If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.*

Communication: Communication will be primarily through Canvas or e-mail.

Lectures/Class: As the class will meet once per week, attendance will be essential.

Homework: Homework will be submitted through Canvas and will be assigned on Mondays

Late Homework: Late assignments will receive a penalty of 10% per day late.

Exams: This is a course with no exams but weekly quizzes to ensure continued learning.

Calculation of Course Grade: A weighted average grade will be calculated as follows:

- **Homework 15%**
- **Quizzes 20%**
- **Class Project 35%**
- **Presentation 20%**
- **Participation 10%**

The minimum requirements for final letter grades are as follows:

A = 90.0%, B+ = 85.0%, B = 80.0%, C+ = 75.0%, C = 70.0%, D = 60.0%, F < 60.0%

Your final grade will be assigned according to the categories above based on the percentages given in the assignments section. I reserve the right to give a higher letter grade (based on perceived effort, improvement throughout the semester, and similar factors), but I will not reduce the grade you have earned.

Instructor Commitment: You can expect the Instructor to be courteous, punctual, organized, and prepared for lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if office hours are moved; to provide a suitable guest lecturer or pre-recorded lecture when they are traveling or unavailable; and to grade uniformly and consistently.

Student Expectations: Successful students actively participate in class and in team meetings and take responsibility for their own learning. Active participation requires being present, engaging with the concepts, and not being distracted by other activities. Failure to participate fully will likely result in grades below your expectations.

Students with Documented Disabilities: NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require accommodations, please contact the Coordinator of Student Disability Services located in the Center for Counseling and Psychological Services, in Campbell Hall, Room 205, (973) 596-3414. Further information on disability services related to the self-identification, documentation and accommodation processes can be found on the webpage at: (http://www.njit.edu/counseling/services/disabilities.php)

Course Schedule:

Week	Date	Topic	Reading
1	11 September	Introduction to Sustainability	T&S Chapter 1
2	18 September	Principles of Sustainable Environmental Engineering	T&S Chapter 3
3	25 September	Interconnected Systems	T&S Chapter 4
4	2 October	Introduction to Life Cycle Analysis (LCA)	LCA Chapters 1 & 2
5	9 October	LCA for Infrastructure	LCA Chapters 3 & 4
6	16 October	Applying LCA	LCA Chapter 5, T&S Chapter 15
7	23 October	Stormwater and Green Infrastructure	T&S Chapter 9
8	30 October	Drinking Water Treatment	T&S Chapters 11 (read) & 12 (skim)
9	6 November	Sanitation	Lüthi Chapter 7, T&S Chapter 2
10	13 November	Wastewater & One Water	T&S Chapter 10
11	20 November	Solid Waste	Wong Chapter 18 (skim) & 19, T&S Chapter 14
12	27 November	Resiliency	T&S Chapter 5 & 6
13	4 December	Renewable Inputs	T&S Chapter 7 & 8
14	11 December	Final Presentations	

Outcomes Course Matrix – EnE 482 Sustainable Environmental Infrastructure

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Students will develop an understanding of sustainability that is informed by multiple definitions, including the Envision framework.			
Assess engineering projects based on their sustainability.	2, 4, 7	1, 2	Homework, Quizzes, Final Project
Student Learning Outcome 2: Students will analyze the underpinnings of life cycle analysis and how it informs decisions about sustainability.			
Estimate the effect of a design choice on the final Life Cycle Assessment	1, 2, 4, 6	1, 2	Quizzes, Homework
Provide an overview of an LCA analysis applied to a project	1, 2, 4, 6, 7	1, 2	Homework, Final Project
Student Learning Outcome 3: Students will develop an awareness of environmental justice concepts and issues.			
Provide environmental justice considerations for a proposed project.	2, 4	1, 2, 3	Class and group Discussions Homework, Final Project
Student Learning Outcome 4: Students will gain an understanding of relevant technologies and examples for multiple environmental infrastructure areas and be able to evaluate their advantages and disadvantages.			
Choose the best green infrastructure technology for a given situation	1, 2, 4	1, 2, 3	Homework, Quizzes, Final Project
Integrate sanitation, water, and wastewater treatment under the concept of “One Water”.	2, 4	1, 2	Homework, Quizzes, Final Project
Evaluate societal and construction practices on pollution.	2, 4	1, 2, 3	Homework, Quizzes, Project
Student Learning Outcome 5: Students will study a sustainable infrastructure choice in depth, referencing academic and non-academic literature to create a research report and presentation on a sustainable infrastructure solution of their choosing.			

Prepare a written report by integrating course material with reading other literature	2, 3, 4, 5, 6, 7	1, 2, 3	Final Project
Give an oral presentation to class based on findings of report	3, 5, 7	1, 2	Final Project

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our Program Educational Objectives are reflected in the achievements of our recent alumni:

1. Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
2. Professional Growth: Alumni will advance their technical and interpersonal skills through professional growth and development activities such a graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.
3. Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies