ENE 465: Sustainable Environmental Infrastructure

(3 credits)

Lectures Mondays, 6:00 PM – 8:50 PM
Central King Building 126

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Office Hours: Wednesdays 1:30–3:00 PM
Fridays 1:30–3:00 PM

Prerequisite 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. ISBN: 978-1-119-08563-8 https://www.wiley.com/en-us/Sustainable+Environmental+Engineering-p-9781119085584

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

Other Recommended Texts & Reading

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 *(from NJIT's course catalog)*

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. Sustainability: Students will develop an understanding of sustainability that is informed by multiple definitions, including the Envision framework.
2. Life Cycle Analysis: Students will analyze the underpinnings of life cycle analysis and how it informs decisions about sustainability.
3. Environmental Justice: Students will develop an awareness of environmental justice concepts and issues.
4. Design: 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. Infrastructure: 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 and will be recorded and counted toward the Participation score.

Handouts: Handouts will be provided digitally on Canvas.

Homework: Homework will be submitted through Canvas and will be assigned on Fridays.

Homework Format: Homework can include both writing- and calculation-based questions. Writing is best down in a word processing software, while calculations are often best done with pencil on engineering paper or similar. The former can be directly converted to PDF, and the latter can be scanned as a PDF. When problems of both kinds are included in an assignment, please combine the PDFs using, for example, Adobe Acrobat available on campus desktops. When calculations are done in a program like Excel, it is helpful to also include the source file in addition to the PDF.

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

Homework Solutions: After all students have submitted work (or 10 days after it was due), printed solutions will be made available at the next lecture with the opportunity to discuss them.

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%
In-Class Quizzes	20%
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.

AI statement: The use of artificial intelligence (AI) is permitted in this course only when explicitly stated in assignments. If students use AI for any course-related work, they must cite it according to the guidelines provided on the **NJIT Library AI Citation page**. If you have any questions about AI use in this course, please contact the course instructor before submitting any assignments. In cases where AI use is not allowed, students are expected to complete work without AI assistance to develop their skills in this subject area.

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	22 January	Introduction to Sustainability	T&S Chapter 1
2	29 January	Principles of Sustainable Environmental Engineering	T&S Chapter 3
3	5 February	Interconnected Systems	T&S Chapter 4
4	12 February	Introduction to Life Cycle Analysis (LCA)	LCA Chapters 1 & 2
5	19 February	LCA for Infrastructure	LCA Chapters 3 & 4
6	26 February	Applying LCA	LCA Chapter 5, T&S Chapter 15
7	5 March	Stormwater and Green Infrastructure	T&S Chapter 9
8	12 March	Drinking Water Treatment	T&S Chapters 11 (read) & 12 (skim)
9	19 March	SPRING RECESS	
10	26 March	Sanitation	Lüthi Chapter 7, T&S Chapter 2
11	2 April	Wastewater & One Water	T&S Chapter 13 & 10
12	9 April	Solid Waste	Wong Chapter 18 (skim) & 19, T&S Chapter 14
13	16 April	Resiliency	T&S Chapter 5 & 6
14	23 April	Renewable Inputs	T&S Chapter 7 & 8
15	30 April	Final Presentations	

Course Objectives Matrix – EnE 465 – 101

Strategies and Actions	Course Student Learning Outcomes	Student Outcomes (1-7)	Program Educational Objectives	Assessment Methods/Metrics
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.	1, 4	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	2, 4, 5	1, 2, 4, 6	1, 2	Quizzes, Homework
Provide an overview of an LCA analysis applied to a project	2	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.	3, 4	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, 4, 5	1, 2, 4	1, 2, 3	Homework, Quizzes, Final Project
Integrate sanitation, water, and wastewater treatment under the concept of "One Water".	1, 4	2, 4	1, 2	Homework, Quizzes, Final Project
Evaluate societal and construction practices on pollution.	1, 4	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	1, 5	2, 3, 4, 5, 6, 7	1, 2, 3	Final Project
Give an oral presentation to class based on findings of report	1, 5	3, 5, 7	1, 2	Final Project

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

- **Engineering Practice:** Alumni will successfully engage in the ethical practice of civil engineering within industry, government, and private practice, working towards safe, practical, resilient and sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
- **Professional Growth:** Alumni will advance their technical and interpersonal skills through professional growth and development activities such as graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as academia, business, and law through further education.
- **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.

Student Outcomes

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

- an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
- 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
- an ability to communicate effectively with a range of audiences
- 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
- 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
- an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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