

# Ecological Engineering & Science

FABE/ENR 5310, Spring 2024

## Course Information

- **Course times:** Mondays and Wednesdays, 9:10 -11:00am.
- **Location:** Kottman Hall 104
- **Credit hours:** 4
- **Mode of delivery:** In-person

## Instructors & Assistants

**Jay Martin** (he/his/him), Department of Food, Agricultural & Biological Engineering

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- **Office hours:** by appointment, please contact me via email
- **Preferred means of communication outside of class:** email

**Elizabeth Myers Toman** (she/her), School of Environment and Natural Resources

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- **Office hours:** virtual only by appointment, please contact me via email
- **Preferred means of communication outside of class:** email

**Jordan Inskeep** (he/him), School of Environment and Natural Resources

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- **Preferred means of communication outside of class:** email



## Course Prerequisites

Junior standing with at least one course in one of the following subject areas; biology, ecology, engineering, or geology.

## Course Description

Our course focuses on the definition, classification, and practice of ecological engineering. We will describe ecosystems, ecosystem restoration, and utilizing natural processes to provide societal services and benefits to nature. Our course provides the basic background for design of ecological engineering projects and for some of the practices that make up ecological engineering such as river revitalization, wetland design, and runoff management.

## Learning Objectives and Outcomes

We expect students to be active participants in class. During lecture sessions we will encourage you to improve your critical thinking abilities by engaging in classroom discussions and activities as a thoughtful and considerate participant.

By the end of this course, students should successfully be able to:

- Identify the key physical, biogeochemical and ecological processes occurring in ecosystems and utilize these processes to provide societal services;
- Identify the benefits of ecological engineering technologies (i.e., holistic solutions, energy savings, costs savings);
- Apply natural processes to guide restoration and creation of ecosystems; and
- Understand the fundamental design considerations of ecologically engineered systems.

These objectives will be achieved with a combination of lectures, assigned exercises, readings, and a design project. A detailed class schedule, listing the topics that will be taught is attached.

## How This Course Works

### Mode of delivery:

This course is held **in-person**. Lectures are each week on Monday and Wednesdays from 9:10-11:00 a.m. Although lecture materials (powerpoints) are provided in CarmenCanvas, we expect you to be present and actively engaged in each lecture session. Assignment and their associated deadlines will be posted in CarmenCanvas. The content of lecture sessions will vary throughout the term and could include: instructor lecture, small group discussions, individual or group activities, student presentations, and guest lectures. Lectures will be



broadcast live via CarmenZoom and recorded for those who are unable to attend in person due to illness or other extenuating circumstances.

**Credit hours and work expectations:** This is a 4 credit-hour course. According to [Ohio State bylaws on instruction](https://go.osu.edu/credithours) (go.osu.edu/credithours), students should expect around 4 hours per week of time spent on direct instruction (instructor content and CarmenCanvas activities, for example) in addition to 8 hours of homework (reading and assignment preparation, for example) to receive a grade of C, average.

**Attendance and participation requirements:** Research shows regular participation is one of the highest predictors of success. With that in mind, we have the following expectations for everyone's participation:

- **Participating in lecture meeting for attendance: twice per week**  
Attendance will be taken randomly throughout the term and will count towards your grade. If you have a situation that might cause you to miss an entire week of class, discuss it with us *as soon as possible*.
- **Participating in online activities: at least once per week**  
You are expected to log in to the course in CarmenCanvas every week to access course content, including readings, and submit assignments.
- **Participating in group project: attend and participate in group meetings and complete responsibilities**  
A group design project is an important part of this course and accounts for 30% of your final grade. You are expected to attend group meetings (in and out of class), and complete portions of the project assigned to you and integrate them with contributions of other students.

## Course Materials, Fees, and Technologies

### Textbook and Readings

- Mitsch, W.J. and Jorgensen, S.E. 2004. Ecological Engineering: and Ecosystem Restoration. John Wiley & Sons, New York. **(relevant chapters will be made available on CarmenCanvas).**
- Additional readings will be assigned throughout the course and will be available through CarmenCanvas.

## Required Equipment

- **Computer:** current Mac (MacOS) or PC (Windows 10) with high-speed internet connection.
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

If you do not have access to the technology you need to succeed in this class, review options for [technology and internet access](https://go.osu.edu/student-tech-access) (go.osu.edu/student-tech-access).

## CarmenCanvas Access

You will need to use [BuckeyePass](https://buckeyepass.osu.edu) (buckeyepass.osu.edu) multi-factor authentication to access your courses in CarmenCanvas. To ensure that you can connect to CarmenCanvas at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](https://go.osu.edu/add-device) (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes, good for 365 days, that can each be used once.
- [Install the Duo Mobile application](https://go.osu.edu/install-duo) (go.osu.edu/install-duo) on all your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at [614-688-4357 \(HELP\)](tel:614-688-4357) and IT support staff will work out a solution with you.

## Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions, or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat:** [go.osu.edu/it](https://go.osu.edu/it)
- **Phone:** [614-688-4357 \(HELP\)](tel:614-688-4357)
- **Email:** [servicedesk@osu.edu](mailto:servicedesk@osu.edu)



# Grading and Faculty Response

## How Your Grade is Calculated

| Assignment Category                | Percentage |
|------------------------------------|------------|
| Homework Assignments (4)           | 20         |
| Mid-term Exam I                    | 20         |
| Mid-term Exam II                   | 20         |
| Project – Preliminary Presentation | 5          |
| Project – Final Presentation       | 10         |
| Project - Report                   | 15         |
| Class Participation                | 10         |
| <b>Total</b>                       | <b>100</b> |

See [Course Schedule](#), below, for due dates.

## Descriptions of Course Assignments and Assessment

The lecture and reading content will expose you to a fundamental understanding of ecological engineering in order to achieve the course objectives listed above. The lecture sections will also help guide you through the design project that we will work on during the term.

We will post reading assignments on CarmenCanvas each week and some class discussion during lecture sessions will center on the reading assignment. Some time each week will be reserved for group work and discussion of the design project. In addition, **every student will be asked to give a short synopsis once during the term of a research article** that describes an application of ecological engineering.

## Homework Assignments

**Description:** Homework assignments (4) will assess how well you can synthesize course material. These will include essay questions, calculations, and drawing diagrams. You will complete the assignments on your own and submit your work via CarmenCanvas.

## Exams

**Description:** Two midterms will determine your degree of mastery of specific material covered in the course. They will test your knowledge of the topics and content presented in lectures and readings **but will not cover group project details**. Exams are open note and book, meaning that you can reference course materials during the exam. However, outside materials (internet sources) should not be used.

## Design Project

**Description:** This problem-based learning course will focus on applying the concepts of Ecological Engineering to stormwater runoff. You will be assigned to a team of approximately 5-6 students. Each team will deliver two oral presentations: a short presentation to present the preliminary ideas and a final presentation to describe the design. As a team, you will also submit a written report detailing the proposed project that is due on the last scheduled day of the term. You will complete a quick survey indicating the relative contribution of each team member. Team members will receive a similar grade **unless** there are major discrepancies in individual contributions as indicated by student feedback or the student in question is not present for the presentations.

## Participation

**Description:** Participation accounts for 10% of your grade in this class. You will be awarded participation points for:

1. Attending lecture sessions (attendance taken randomly),
2. Participating in lecture discussions and activities,
3. Contributing equally/appropriately to your team project, and
4. Delivering a research application synopsis.

Approximately half of the participation points are associated with specific activities (such as the research application synopsis and attendance at the site visit) and the other half will be assigned at the instructors' discretion based on overall attendance and participation. A breakdown of the participation points is available in CarmenCanvas.

**Academic integrity and collaboration for course assignments:** Your written homework assignments should be your own original work. In your team project report, you should be



consistent in following citation style [MLA/APA/Chicago etc.] to reference the ideas and words of your research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in but no one else should revise or rewrite your work. Your exams, while open book, are not open neighbor or friend.

## Late Assignments

Please refer to CarmenCanvas for due dates. Due dates are set to help you stay on pace and to allow timely feedback that will help you complete subsequent assignments. **Late assignments will only be accepted in extenuating circumstances and with *prior* approval.**

As we are sure you expect us to be well prepared and come to class for every session, we expect the same from you. If you must leave lecture early, please let one of us know. Missed attendance and exams due to emergencies or illness will be handled on a case-by-case basis and require formal documentation for excuse or re-schedule. **Please notify us immediately when an emergency situation arises.**

## Instructor Feedback and Response Time

We are providing the following list to give you an idea of my intended availability throughout the course. Remember that you can call [614-688-4357 \(HELP\)](tel:614-688-4357) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact us first through our Ohio State email addresses. We will reply to emails within **24 hours on days when class is in session at the university.**
- **Class announcements:** We will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check [your notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Grading and feedback:** We will try to provide feedback and grades within **seven days** of assignment due date.

## Grading Scale

|           |           |             |
|-----------|-----------|-------------|
| 93–100: A | 80–82: B- | 67–69: D+   |
| 90–92: A- | 77–79: C+ | 60–66: D    |
| 87–89: B+ | 73–76: C  | Below 60: E |
| 83–86: B  | 70–72: C- |             |



# Other Course Policies

## Communication Guidelines

The following are our expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online or in writing.

## Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this class.

## Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](http://studentconduct.osu.edu) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so we recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

**If we suspect that a student has committed academic misconduct in this course, we are obligated by university rules to report my suspicions to the Committee on Academic Misconduct.** If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.





If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact us.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

## Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Office of Institutional Equity:

1. Online reporting form at [equity.osu.edu](http://equity.osu.edu),
2. Call 614-247-5838 or TTY 614-688-8605,
3. Or Email [equity@osu.edu](mailto:equity@osu.edu)

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university



employees have reporting responsibilities to the Office of Institutional Equity to ensure the university can take appropriate action:

- All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.
- The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member."

This course adheres to The Principles of Community adopted by the College of Food, Agricultural, and Environmental Sciences. These principles are located on the CarmenCanvas site for this course; and can also be found at <https://go.osu.edu/principlesofcommunity>. For additional information on Diversity, Equity, and Inclusion in CFAES, contact the CFAES Office for Diversity, Equity, and Inclusion (<https://equityandinclusion.cfaes.ohio-state.edu/>). If you have been a victim of or a witness to a bias incident, you can report it online and anonymously (if you choose) at <https://studentlife.osu.edu/bias/report-a-bias-incident.aspx>.

## Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are located, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, [on-demand mental health resources](https://go.osu.edu/ccsondemand) ([go.osu.edu/ccsondemand](https://go.osu.edu/ccsondemand)) are available. You can reach an on-call counselor when CCS is closed at [614- 292-5766](tel:614-292-5766). **24-hour emergency help** is available through the [National Suicide Prevention Lifeline website](https://suicidepreventionlifeline.org) ([suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)) or by calling [1-800-273-8255\(TALK\)](tel:1-800-273-8255). [The Ohio State Wellness app](https://go.osu.edu/wellnessapp) ([go.osu.edu/wellnessapp](https://go.osu.edu/wellnessapp)) is also a great resource.

## Accessibility Accommodations for Students with Disabilities



## Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let us know immediately so that we can privately discuss options. To establish reasonable accommodations, we may request that you register with [Student Life Disability Services \(SLDS\)](#). After registration, make arrangements with us as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's [request process](#), managed by Student Life Disability Services.

### Disability Services Contact Information

- Phone: [614-292-3307](tel:614-292-3307)
- Website: [slds.osu.edu](http://slds.osu.edu)
- Email: [slds@osu.edu](mailto:slds@osu.edu)
- In person: [Baker Hall 098, 113 W. 12th Avenue](#)

## Accessibility of Course Technology

This course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations as early as possible.

- [CarmenCanvas accessibility](http://go.osu.edu/canvas-accessibility) ([go.osu.edu/canvas-accessibility](http://go.osu.edu/canvas-accessibility))
- [CarmenZoom accessibility](http://go.osu.edu/zoom-accessibility) ([go.osu.edu/zoom-accessibility](http://go.osu.edu/zoom-accessibility))

# Course Schedule

Refer to CarmenCanvas course for up-to-date due dates.

| Week | Date     | Topic   | Instructor              | Readings & Assignments   |
|------|----------|---|-------------------------|--|
| 1    | 8 - Jan  | Intro to Ecological Engineering, Definitions and Principles | Jay Martin              | Mitsch and Jorgensen (2004) Chpts 1- 3, & 5  |
|      | 10 - Jan | Ecosystems  | Jay Martin              | Mitsch and Jorgensen (2004) Chpt 4, E.P. Odum (1969) The Strategy of Ecosystem Development. <i>Science</i> .<br><b>HOMEWORK #1, Due: Jan. 22</b>   |
| 2    | 15 - Jan | <i>NO LECTURE – Martin Luther King Jr. Holiday</i>          |                         |  |
|      | 17 - Jan | Ecosystem Services  | Elizabeth Myers Toman   | Reid et al., (2005). Ecosystems and human well-being: Synthesis. A report of the millennium ecosystem assessment. Pages 1-24.<br>Ecosystem Services Fact Sheet. The Ecological Society of America.   |
| 3    | 22 - Jan | Ecosystem Valuation   | Elizabeth Myers Toman   | Costanza et al., (1997) The value of the world's ecosystem services and natural capital. <i>Nature</i> .<br>Farber et al., (2002) Economic and ecological concepts for valuing ecosystem services. <i>Ecol Economics</i><br><b>HOMEWORK #2, Due: Jan. 31</b> |
|      | 24 - Jan | Project Introduction and Expectations                       | Guests, Jay & Elizabeth |  |
| 4    | 29 - Jan | Systems Approach: Bioenergy Analysis                        | Jay Martin              | Ulgiati (2001) A comprehensive energy and economic assessment of biofuels: When "green" is not enough. <i>Bioenergy</i> .  |
|      | 31 - Jan | Life Cycle Assessment                                       | Elizabeth Myers Toman   | Mathews et al., (2017) <u>Life Cycle Assessment: Quantitative Approaches for Decisions that Matter</u> , Chapter 1   |
| 5    | 5 - Feb  | Water and Wetland Treatment Systems                         | Jay Martin              | Mitsch and Jorgensen (2004) Chpt 10  |
|      | 7 - Feb  | Living Machines   | Jay Martin              |  |



|    |               |  |                           |  |
|----|---------------|--|---------------------------|--|
| 6  | 12 - Feb      | Research paper presentations<br>& <b>Exam Review</b> | Students, Jay & Elizabeth |  |
|    | 14 - Feb      | MIDTERM I  |                           |  |
| 7  | 19 - Feb      | Site Visit   | Guests                    | Meet on site: information provided in class and CarmenCanvas   |
|    | 21 - Feb      | Hydrology-Water Runoff & Projects                    | Jay Martin                | Chapter 5, Environmental Hydrology by Andrew Ward, 2016. GB665.W28 2016  |
| 8  | 26 - Feb      | Rain Gardens & Stormwater management                 | Jay Martin                | Davis et al., (2009) Bioretention Technology: Overview of Current Practice and Future Needs. <i>J of Env. Eng.</i><br><b>Homework #3 Due March 6</b>   |
|    | 28 - Feb      | Preliminary Project Presentations                    | Students                  |  |
| 9  | 4 - Mar       | Green roofs  | Elizabeth Myers Toman     | GSA (2011) The Benefits and Challenges of Green Roofs on Public and Commercial Buildings   |
|    | 6 - Mar       | Permeable Pavements                                  | Elizabeth Myers Toman     | Hunt & Collins, (2008) Permeable Pavement: Research Update and Design Implications.<br><b>Homework #4 Due Mar 20</b>   |
|    | 11 & 13 - Mar | <i>Spring Break, No Class</i>                        |                           |  |
| 10 | 18 - Mar      | Ecological Restoration                               | Elizabeth Myers Toman     | Zedler (2005) Ecological restoration: guidance from theory, Hobbs and Norton (1996), Towards a conceptual framework for restoration ecology  |
|    | 20 - Mar      | Restoration: How much is too much?                   | Jay Martin                | Prado-Jatar & Brown (1997) Interface ecosystems with an oil spill in a Venezuelan tropical Savannah <i>Eco Eng</i><br>Rohr et al., (2018) The ecology and economics of restoration. <i>Ecoology and Society</i>  |
| 11 | 25 - Mar      | Design Workshop                                      | Jay & Elizabeth           |  |
|    | 27 - Mar      | BluePrint Columbus: Rain Gardens Case Study          | Jay Martin                | Effects of watershed-scale green infrastructure retrofits on urban stormwater quality: A paired watershed study to quantify nutrient and sediment removal. <i>Ecological Engineering</i> . 186. 106835.<br>Hydrologic impacts of sewershed-scale green infrastructure retrofits: Outcomes of a four-year paired watershed monitoring study. <i>Journal of Hydrology</i> . 611: 128014. |



|         |            |  |                       |   |
|---------|------------|--|-----------------------|---|
| 12      | 1 - April  | Sponge Cities  | Elizabeth Myers Toman | How to Build a City That Doesn't Flood? Turn it Into a Sponge!<br><a href="https://centerforsi.org/index.php/2017/12/18/sponge/">https://centerforsi.org/index.php/2017/12/18/sponge/</a> |
|         | 3 - April  | Current applications of Ecological Engineering                       | TBD                   |   |
| 13      | 8 - April  | Grad student research in Ecological Engineering & <b>Exam Review</b> | Students              |   |
|         | 10 - April | MIDTERM 2  |                       |   |
| 14 & 15 | 15 - April | Case Study in Ecological Restoration: Olentangy dam removal          | Guest: Laura Fay      | Meet in class, walk to Olentangy  |
|         | 17 - April | Wetland delineation/ Wetlands research                               | Jay Martin            | Meet at Schiermeier Wetland Research Park   |
|         | 22 - April | Final Presentations  | Students              |   |

