# ERE 575 Ecological Engineering for Water Quality

Fall 2022
3 credit hours
**Class meeting times:** Monday and Wednesday 2:15 – 3:35 pm @Baker 432

**Instructor of record:** Wendong Tao
Baker 422; (315) 470-4928; wtao@esf.edu
**Office hours:** Mondays 11:00-12:00 or by appointment

**TA:** Pubudu Wickramasinghe
Baker 321; pwickram@syr.edu

## Course Description:

3 hours of lecture/seminar/discussion per week. Design and analysis of ecological treatment systems for water quality improvement. Hands-on construction, operation and/or monitoring of engineered ecosystems through group project activities beyond class meeting times in on-campus labs and a greenhouse. Focusing on constructed wetlands, with minor topics selected by students. Fall.

**Prerequisite:** ERE 275 Ecological Engineering, or equivalent.

**Course Learning Outcomes:**

After completing this course, the students will be able to:

1. Apply knowledge of chemistry, biology, geoenvironmental engineering, ecology, hydrology and hydraulics for sound design and evaluation of ecological water and wastewater treatment systems;
2. Design constructed wetlands, ponds and hybrid wastewater treatment systems for various applications;
3. Design and implement a monitoring program to evaluate the performance of ecological treatment systems for water quality improvement; and
4. Design and conduct experiments to explore the potential mechanisms of ecological treatment and derive design considerations.

**Program (ERE) Learning Outcomes:**
(I = Introduction, R = Reinforce, E = Emphasize; A = ABET Criteria 3 assessment)

1. [E] an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics
2. [I] an ability to apply engineering design to produce solutions that meet specific needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. [I] 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 judgements, which must consider the impact of engineering solutions in a global, economic, environmental, and societal context
5. [I] 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. [R] 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

**Textbooks and Supplies:**

- Learning Guide. To be accumulated over the semester.
- Kadlec R.H., and Wallace S.D. 2009. Treatment Wetlands, 2nd edition. CRC Press Taylor & Francis Group, Boca Raton, FL. ISBN 978-1-56670-526-4. Moon Library reserves, Call # TD755.K33 2009. Suggested reading.
- Crites R.W., Middlebrooks E.J., Bastian R.K., and Reed S.C. 2014. Natural Wastewater Treatment Systems, 2nd ed. CRC Press, Boca Raton, FL. ISBN 978-1-4665-8326-9. 1st ed. Moon Lib reserves, Call # TD755.C75. Suggested reading.

**Course Schedule:**

| | |
|---|---|
| Overview of constructed wetlands | 1. Introduction to Constructed Wetlands<br>1.1 Natural wetlands<br>1.2 Concepts of constructed wetlands<br>1.3 Application of constructed wetlands<br>1.4 Performance evaluation of ecological treatment systems<br>1.5 Empirical design of constructed wetlands |
| Ecological design principles; kinetic-based design | 2. Overview of Ecological Engineering<br>2.1 Definitions of ecological engineering<br>2.2 Design principles of ecological treatment systems<br>2.3 Kinetic models for water quality of ecological treatment systems |
| Configuration and treatment processes | 3. Engineering Analysis of Constructed Wetlands<br>3.1 General design considerations<br>3.2 Soil and other media<br>3.3 Hydrophytes<br>3.4 Hydrology and hydraulics<br>3.5 Microorganisms, animals and food chains |
| Case studies on ecological treatment | |
| Topical reviews of ecological treatment | |
| Class projects on constructed wetlands | |

**Grading:**

| | | |
|---|---|---|
| a. | Participation in group lab/field activities and November 2nd tour | 8% |
| b. | Group presentation of case studies (October 24 & 26) | 11% |
| c. | Assignments (October, November, December) | 30% |
| d. | Presentation of topical review (November 9 & 16) | 13% |
| e. | Group presentation of projects (November) | 13% |
| f. | Final project report (December 12th 11:59 pm) | 25% |

Late policy: You will lose 10% of marks for one-day delay, 25% for two-day delay, and 50% for three-day delay, and 100% thereafter for assignments and final report. Missing one group activity incurs 3% loss. Presentations must be given on time as scheduled.

| Letter grade | % scores |
|---|---|
| A | >93 |
| A- | ≥89 |
| B+ | ≥85 |
| B | ≥80 |
| B- | ≥75 |
| C+ | ≥71 |
| C | ≥67 |
| C- | ≥63 |
| D | ≥60 |
| F | <60 |

**Attendance Policy:**

Classroom attendance and participation in group activities are required.

Group projects (3 persons each group):

Group $\alpha$, $\beta$, and $\gamma$ – weekly operation of constructed wetlands in the Old Greenhouse (3 consecutive weeks each group)

Group $\varphi$ -- investigation into macrophytes (and/or rooting substrate) of constructed wetlands

Group $\Omega$ – ammonia removal kinetics and water quality analysis

Group $\delta$ -- investigation into microorganisms of free water surface wetlands

Topics suggested for topical review:

1. Techniques of wetland planting
2. Methods to control mosquito issue of free water surface wetlands
3. Release of organic substrates by growing and senescent plants in constructed wetlands
4. Contribution of plant harvesting to water quality improvement in constructed wetlands
5. Adsorption capacity of different wetland media for phosphorus
6. Capital and operational costs of constructed wetlands
7. Greenhouse gas emission from constructed wetlands
8. Removal of pharmaceuticals and personal care products in constructed wetlands

9. Removal of pathogens in constructed wetlands
10. Removal of per- and polyfluoroalkyl substances (PFASs) in constructed wetlands
11. Effects of rain gardens/bioretention basins on water quality
12. Effects of green roofs on water quality

**Students with Learning and Physical Disabilities**

SUNY-ESF works with the Office of Disability Services (ODS) at Syracuse University, who is responsible for coordinating disability-related accommodations. ODS is responsible for coordinating disability-related academic accommodations and will work with the student to develop an access plan. Since academic accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible to begin this process. To discuss disability-accommodations or register with ODS, please visit their website at http://disabilityservices.syr.edu. Please call (315) 443-4498 or email disabilityservices@syr.edu for more detailed information.

**Academic Dishonesty**

Academic dishonesty is a breach of trust between a student, one's fellow students, or the instructor(s). Examples of academic dishonesty includes but is not limited to plagiarism and cheating, and other forms of academic misconduct. By registering for courses at ESF you acknowledge your awareness of the ESF Code of Student Conduct. More information regarding Academic Integrity, including the process for resolving alleged violations, can be found in the Student Handbook (https://www.esf.edu/students/handbook/).

**Religious Holiday Observance**

All students have a right under NYS law and ESF college policy to observe the religious holidays of their choice, according to their individual faith. If students wish to observe a religious holiday, they should provide written notification to the instructor and/or TA (via email) of their intent to observe a particular religious holiday within the first two weeks of the semester, and prior to missing any required course meetings or activities. Reasonable requests for absence from course meetings or activities will be accommodated whenever possible, though students may be responsible for independently making up missed materials or activities on their own time, and in a timely fashion.

**Covid-19 Guidance**

Students are required to follow the college's evolving Covid-19 protocols and restrictions, which can be found on the college website at: https://www.esf.edu/restart/