Fall 2020

ENE 485-HM1: Special Topic: Biogeochemical Applications in Environmental Engineering

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NJIT New Jersey's Science & Technology University

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

EnE 485/702 Biogeochemical Applications in Environmental Engineering Fall 2020

Course Description:

This class will combine theoretical concepts with laboratory and field studies to integrate the basic principles of environmental engineering, chemistry and microbiology to solve practical problems of assessment and treatment of contaminated sites. In the lectures, the students will be introduced to environmental regulations, the theoretical concepts for environmental sampling design, the procedures for analytical techniques, and traditional and cutting-edge remediation approaches. These lectures will be supplemented with peer-reviewed articles, technical reports, and operational methods. Using this information, the students will evaluate two or three remediation strategies and will propose one final remediation design.

Course objectives:

1. The students will learn how to properly collect and process environmental samples for site characterization.
2. The students will apply different analytical techniques to assess the level of contamination.
3. The students will design a remediation approach to tackle a real contaminated site using the information obtained in this course

Canvas: Course materials will be available on Canvas. The use of Canvas is encouraged, including Discussion Groups and Chats.

Instructor:

Prof. Lucia Rodriguez-Freire
Lecture: Synchronous Online, Tuesday 6-9 pm
Office Hours: Tuesday 4-5 pm
Thursday 9-11 am
Also available by appointment
WebEx: https://njit.webex.com/meet/irfreire
Email: lrfreire@njit.edu

Suggested Texts

Handbook of Environmental Engineering, Rao Y. Surampalli, Ph.D., P.E., BCEE, Dist.M.ASCE; Tian C. Zhang, Ph.D., P.E., BCEE, F.ASCE; Satinder Kaur Brar, Ph.D.; Krishnamoorthy Hegde, Ph.D.; Rama Pulicharla, Ph.D.; Mausam Verma, Ph.D. Handbook of Environmental Engineering (McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2018).
https://www-accessengineeringlibrary-com.libdb.njit.edu:8443/content/book/9781259860225

EPA Superfund program: https://www.epa.gov/superfund

Contaminated Sites Clean-Up Information Website: https://clu-in.org/issues/default.focus/sec/Global_Efforts_to_Advance_Remediation_at_Contaminated_Sites/cat/Overview/

EPA Environmental Sampling and Analytical Methods (ESAM) program: https://www.epa.gov/esam

Research papers, reports, and book chapters will be distributed to the students as needed.

Meeting	Date	Topics	Student Learning Outcomes
1	Sept. 1	Introduction to Biogeochemical Cycles	1. Get familiarized with the class objectives 2. Define biogeochemical cycles 3. Introduction to oxygen, carbon and nitrogen biogeochemical cycles
2	Sept. 15	Environmental Law; CERCLA	1. Describe the environmental regulatory environment 2. Identify the main regulatory mechanisms for Environmental Remediation in the U.S. 3. Understand CERCLA and Superfund Law, and the Parts of the Remedial Investigation/Remedial Design (**Report**)
3	Sept. 22	Type of Contaminants and the Terrestrial and Aquatic Environments	1. Identify the different types of contaminants and their properties 2. Understand the environment from an integrated physical, chemical and biological perspective 3. Define the components of soil and aquatic environments and their characteristics
4	Sept. 29	Fate of Contaminants: Physical and Chemical Processes	1. Understand physical transport of contaminants: advection, dispersion, diffusion 2. Describe chemical transformation of contaminants and their effect on contaminant fate
5	Oct. 6	Fate of Contaminants: Biological Processes	1. Identify biological processes controlling contaminant fate 2. Integrate biological, chemical and physical mechanisms on contaminant fate
6	Oct. 13	Environmental Sampling	1. Describe sampling strategies for adequate representation 2. Differentiate different sampling techniques for water, soil and biological samples
7	Oct. 20	Sample Processing and Analytical Tools	1. Define main process to ensure proper sample preparation for analysis 2. Identify analytical tools for environmental and contaminant characterization
8	Oct. 27	Environmental Remediation: Physical Mechanisms	1. Understand the difference between *in situ, ex situ* and *off site* remediation 2. Define the main physical-based processes for environmental remediation. Mainly, evapotranspiration covers, solid stabilization, thermal treatments, rock fracture 3. Identify the pros and cons for each process
9	Nov. 3	Environmental Remediation: Chemical Mechanisms	1. Define the main chemical-based processes for environmental remediation. Mainly air sparging, electrokinetics, chemical oxidation and reduction, sorption processes, solvent extraction 2. Identify the pros and cons for each process
10	Nov. 10	Environmental Remediation: Biological Mechanisms	1. Define the main biological-based processes for environmental remediation. Mainly bioreactors, biodegradation, bioremediation, permeable reactive barriers, phytodegradation 2. Identify the pros and cons for each process

11	Nov. 17	Environmental Remediation of Organic Contaminants: Case Studies	Discuss and compare actual efforts for environmental remediation for organic contaminants
12	Nov. 24	Environmental Remediation of Heavy Metals: Case Studies	Discuss and compare actual efforts for environmental remediation for heavy metals
13	Dec. 1	Presentations 1	
14	Dec. 8	Presentations 2	
	Dec. 15	**FINAL REPORTS DUE**	

Lectures

- It's important that you read the assignment prior to class. We will try to spend class time summarizing important points from the readings and working on practical examples.
- It is required that students attend class. Information will be provided that will be critical to student performance
- Please be on time for lectures, mute your mic unless for asking a question and be mindful of the technical limitations.

Homeworks

Homeworks will be due at the beginning of the class period on the date specified by the instructor. You are strongly encouraged to work in groups, but due to this semester's circumstances you can choose to work alone in your homework and final report. Please, feel free to consult with me if questions arise for homework assignments. Everyone in the study-group must read and sign the homework before submission via email or Canvas.

Grading Policy:

During this class, you will work in preparing a Remedial Investigation/Remedial Decision report for a Superfund site. The final report will be done through the completion of homework and tasks. The final RI/RD will be presented to the whole class in a mock Community Advisory Group (CAG) session the last two classes.

- Homework (35%)
- Class Project (35%)
- Presentation (20%)
- Participation (10%)

Grading Scale:

ENE 485

A:	100-90
B+:	89-85
B:	84-80
C+:	79-75
C:	74-70
D:	69-60
F:	Below 60

ENE 702

A:	100-90
B+:	89-85
B:	84-80
C+:	79-75
C:	74-70
F:	Below 70

Withdrawals:

In order to insure consistency and fairness in application of the NJIT policy on withdrawals, student requests for withdrawals after the deadline will not be permitted unless extenuating circumstances (e.g., major family emergency or substantial medical difficulty) are documented. The course Professors and the Dean of Students are the principal points of contact for students considering withdrawals.

NJIT Honor Code:

"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*

Syllabus Information:

The dates and topics of the syllabus are subject to change; however, students will be consulted with and must agree to any modifications or deviations from the syllabus throughout the course of the semester.

Outcomes Course Matrix – EnE 485/702 Biogeochemical Applications in Environmental Engineering

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Students will understand the mechanisms controlling the fate and transport of contaminants in environmental systems			
Students will learn and apply physical, chemical and biological concepts in environmental engineering	1, 6, 7	1, 2	Class and group discussions Homework and final project
Students will learn the importance of contaminant and environmental characteristics to predict and remediate contaminated sties	1, 6, 7	1, 2	Class and group discussions Homework and final project
Student Learning Outcome 2: Students will learn to assess environmental remediation strategies for different contaminant types			
Students will learn to formulate remediation strategies to comply with current and future environmental legislation	1, 2, 6, 7	1, 2	Class and group discussions Homework and final project
Students will integrate engineering advances with societal needs and legislation/economic limits to design environmental remediation strategies	2, 4, 5, 6, 7	1, 2, 3	Class and group discussions Homework and final project
Student Learning Outcome 3: Students will develop the tools to solve problems with complex physical, chemical and biological reactions in natural and engineer systems			
Students will design the best remedial design for a contaminated site	1, 2, 4, 5, 6, 7	1, 2	Class and group discussions Homework and final project
Students will defend their proposed project in a Mock presentation to the “affected community” with interested stakeholders	1-7	1, 2, 3	Class and group discussions Homework, final project and presentation

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

Revised: 2/13/18