# ENE 663 Environmental Water Chemistry - Fall 2017

**INSTRUCTOR:** Dr. Lucia Rodriguez-Freire
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**CLASS MEETING:** Thursdays**,** 6 - 9 pm
Kupfrian Room 202

**OFFICE HOURS:** Tuesdays 2 – 4 pm
Always by appointment as well.

**Description**: The course provides a comprehensive survey to aqueous-phase equilibria impacting the water quality in natural waters, and water distribution and treatment facilities. We will work to understand the acid-base and metal-ligand equilibria, oxidation-reduction reactions and chemical reaction thermodynamics. There is some emphasis on equilibria governing inter-phase (gas-liquid, solid-liquid) chemical distribution. Mathematical approaches to prediction of equilibrium chemical speciation are stressed.

**Course Objectives and Expected Learning Outcomes:**

1) Students will become familiar with the equilibrium reactions in close and open systems; the interaction between different phases (liquid, gas and solid); and the reduction-oxidation reactions in environmental systems.
2) Students will learn to predict the chemical composition of an aquatic system
3) Students will develop the tools to solve problems with complex chemical reactions in natural and engineer systems

**REQUIRED TEXT:**

- Water Chemistry, 1st Edition,
  Mark Benjamin, Waveland Press, Inc., 2010.

Supplemental Texts:

- Water Chemistry,
  Vernon L. Snoeyink and David Jenkins, John Wiley & Sons, 1980.
- Aquatic Chemistry, 3rd Edition
  Werner Stumm and James J. Morgan, Wiley-Interscience, 1996.

**POLICIES AND PROCEDURES:**
**Lectures:**

- It's important that you read the assignment (text and/or notes) prior to class. We will try to spend class time summarizing important points from the readings, working examples, and getting practice with quizzes.
- Please be on time for lectures, turn off your cell phone and refrain from talking in class, arriving late, leaving class in the middle of a lecture or doing any other activity that could be disruptive to the class.

**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 and to consult with the instructor if questions arise for homework assignments. However, everyone is required to submit his or her own solutions to the homework.

**Exams** are open-book and open-note and they can cover any material presented in the class.

**NJIT Honor Code** will be upheld, and any violations will be brought to the immediate attention of the Dean of Students.

**Schedule Changes** you will be consulted and must agree to any modifications or deviations from the syllabus throughout the course of the semester.

**GRADING:**

- Homework (20%)
- Class Projects (20%)
- Midterm Exam 1 (20%)
- Midterm Exam 2 (20%)
- Final Exam (20%)

**Tentative Course Schedule:**

| Class Date | Topics | Reading |
|---|---|---|
| Sept. 7 | Introduction, General Chemistry Concepts. Chemical Reactivity | Chapter 1<br>Chapter 2 |
| Sept. 14 | Reaction Kinetics and Equilibrium.<br>Introduction to Acid and Base Chemistry | Chapter 3 (3.1-3.6)<br>Chapter 5 (5.1-5.6) |
| Sept. 21 | Graphical and Numerical Solutions for Acid Base Chemistry 1 | Chapter 5 (5.7-5.17) |
| Sept. 28 | Graphical Solutions for Acid Base Chemistry 2<br>Titration, Buffers and the Carbonate System 1 | Chapter 6<br>Chapter 8 (8.1-8.3) |
| Oct. 5 | **Laboratory class:**<br>Titration, Buffers, and the Carbonate System 2 | Chapter 8 (8.5-8.11) |
| Oct. 12 | **Exam 1** | |
| Oct. 19 | Gas-Liquid Equilibrium | Chapter 9 |
| Oct. 26 | Chemistry of Metals in Aqueous Solutions: Metal Complexation | Chapter 10 |
| Nov. 2 | Chemistry of Metals in Aqueous Solutions: Precipitation Reactions | Chapter 11 |
| Nov. 9 | Software for Solving Chemical Equilibrium | Chapter 6 |
| Nov. 16 | **Exam 2** | |
| Nov. 30 | Chemical Thermodynamics<br>Redox Chemistry 1 | Chapter 2<br>Chapter 9 |
| Dec. 7 | Redox Chemistry 2 | Chapter 9 |
| Dec. 14 | **Project presentations** | |
| Dec. 21 | Final Exam | |

**ENE 663 Environmental Water Chemistry: Project Guidelines**

Written Project Specifications: Each student will prepare a brief literature review report consisting of 5 pages maximum (excluding references and tables/figures), single-spaced. The objective of this literature review is to evaluate how your ongoing or proposed future research relates to a selected topic or topics covered in Environmental Engineering Chemistry (e.g., acid-base, complexation, precipitation, redox chemistry). Each student should pick a *unique topic* (no topic duplication will be allowed).

Students are expected to provide a minimum of 2 citations (1 review article and 1 research article; students are more than encouraged to provide more citations if considered necessary). References from relevant scientific journals are preferred. Students are encouraged to consult with their research advisors to get specific names for these publication sources. The use of quantitative analyses that include concepts and equations learned in class is encouraged. The written document will consist of the following sections:

1) Project Title
2) Project Abstract (200 word limit)
3) Background and Significance (Introduction) of the Topic you have selected.
4) Objective of your paper.
5) Theoretical Framework (should specify the concepts from CE 534 that will be applied to your paper)
6) Analyses and Discussion (which should include some calculations); this section can be organized in different specific subtopics.
7) Conclusions.
8) References (you will have to cite any references from which you obtained information, data, equations, and other reference material): you may use the American Psychological Association (APA) citation style format as a reference.
9) An Appendix section should be included that includes figures (e.g., pC-pH diagrams, and others we have seen in class) and tables resulting from the quantitative analyses

*You can use subtitles to help organize thoughts in all sections (see review and research articles as a reference).*

Expected Outcomes:

a) Written Report: The outcome of this project should be a "good quality" written document (this project will be worth *20 points* of your final class grade). Therefore, each student should coordinate with the class instructor to ensure acceptable progress in the quality of the proposed projects.
b) Oral Presentation: A time limit of 7 minutes is given to oral presentations from each student (with the intent to have about 3 minutes for Questions and Answers). Students are encouraged to use slides (e.g. Power Point) as aids to organize and illustrate the presentation.

The following is a tentative timeline for task completion:

| **Task** | **Due Date** |
|---|---|
| Propose Tentative Title and Objective | October 5 |
| Draft 1 (outline, or any similar draft) | November 9 |
| Final Draft: Written Report | December 7 |
| Oral Presentations | December 14 |