

SWS 5406
Soil and Water Chemistry
Distance Education Section

Instructor: Dr. Samira Daroub, Professor, Soil and Water Science Dept

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Teaching Assistant TBA	

Office hours: Always open. Please call or email me. For this semester, I will mostly be in my Belle Glade office all week.

Course Prerequisites: SWS 3022 or SWS 5050 (or equivalent); General Chemistry (CHEM 2046 or equivalent).

Credit Hours: 3 credits

Times: Fall semester odd years.

Enrollment Cap: 20

Delivery Method: Web

Online meetings /Chat sessions: Thursdays 6-7:30 pm. The URL to participate in chats on Adobe Connect for Fall 2015 is: **TBA** Chat dates are posted on class schedule on class website. We will use the same URL for all chats. You may participate by typing or using a microphone/webcam. For an orientation how to use Adobe Connect and other resources please visit: <http://soils.ifas.ufl.edu/distance/resources.html>

Course Overview:

The course will cover the basic principles of soil and water chemistry. The class will cover the fundamentals principles of the properties of soil components and soil reactions that affect plant growth and environmental quality.

Course Objectives:

In this course, we will describe the soil solid and solution phases, introduce the chemical principles necessary to examine the soil environment, and identify the chemical processes that occur in the soil environment and ultimately impact the fate and behavior of substances in soil and other natural water systems.

After finishing this class, you will be able to:

1. Discuss the importance of the soil solution phase in which almost all chemical reactions in the soil occur, and be able to use and understand applications of speciation models.
2. Identify the common primary and secondary minerals, and solids that compose soils; explain their characteristics and potential reactivity in the environment.
3. Distinguish between ion exchange, adsorption, and precipitation reactions.
4. Debate the importance of pH and reduction/ oxidation (redox) status of a soil in dictating the aqueous speciation of an element, as well as reactivity, mobility, and toxicity; develop solubility and pH vs. Eh diagrams; and given the chemical and mineralogical properties of a soil determine which of these processes would dominate.
5. Characterize the chemistry, diagnosis, and reclamation of problematic soils like acid and alkaline soils.

Course Requirements: Students must have an e-mail account, Internet access, access to a computer that meets the [University of Florida computer standards](#), and purchase the following textbook: **Soil and Water Chemistry: An Integrative approach**. M. E. Essington. 2003. CRC Press ISBN 0-8493-1258-2

Course Web Site: Lectures of the class (power point presentations and pdf files), assignments and handouts are posted on the class website **on Canvas**. Go to <http://lss.at.ufl.edu/>, log on using your Gatorlink. If you have registered for the class, the class will show up under E-learning in Canvas. You need to have a gatorlink account <http://www.gatorlink.ufl.edu/> to be able to log on to the class. Please note that E-learning needs Java to work properly. You can download Java from the same website.

Required Text: Soil and Water Chemistry: An Integrative approach. M. E. Essington. 2003. CRC Press ISBN 0-8493-1258-2

Supplemental Reading Materials (Posted on class website)

1. Environmental Chemistry of Soils. M. **McBride**. 1994. Oxford University Press.
2. The Chemistry of Soils. G. **Sposito**. 1989., 2nd edition Oxford University Press.
3. Soil Chemistry. **Bohn**, McNeal, O'Connor, and Myer. 2001 3rd edition. John Wiley Publishers.
4. Chemical Equilibria in Soils. W.L. **Lindsay**. 1979. John Wiley and Sons.
5. Selected Journal articles.

Students Responsibilities

Students are expected to study the assigned text sections and listen to narrated lectures prior to lecture coverage in class. Students are expected to actively participate in class chat discussions.

HW, Class Discussions and Exams:

This class has required HW, discussion posts, and exams as follows: 8 HW, discussion posts, exercises and three on-line exams. Your final grade will be based on the cumulative score for the three lecture exams, homework assignments, discussion posts, and short exercises.

GRADING:

HW:	8 HW @ 20 pts each	= 160 points
Exams:	3 exams @ 100 pts each	= 300 pts
Discussions:		= 40 pts
Bonus points:	3 Exercises @ 5 pts each	= 15 pts
Total = 500 points + 15 bonus points		

Grade Scale:

A	≥ 450 points;
A-	≥ 440 points
B+	≥ 425points
B	≥ 405 points
B-	≥ 395 points
C+	≥ 380 points
C	≥ 360 points
C-	≥ 335 points
D+	≥ 315 points
D	≥ 300 points

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Absences and Make-Up Work

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the

Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see:

<http://www.dso.ufl.edu/SCCR/honorcodes/honorcode.php>.

Software Use:

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

1. *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/*
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Training Programs
 - Community Provider Database

2. *Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/*

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

Distance Classes:

Each online distance learning program has a process for, and will make every attempt to resolve, student complaints within its academic and administrative departments at the program level. See <http://distance.ufl.edu/student-complaints> for more details.

Lecture Outline

Module I

Introduction: Soil Chemistry, Soil Solution & Soil Solids

Section 1: Introduction & Overview of Basic Chemical Principles

Definition of Soil Chemistry
Review of Chemical Principles

Section 2: The Soil Solution

Lecture 1: Soil water sampling; Composition of soil solution

Activity concept, estimation of coefficients & measurements

Lecture 2: Water and ion water interactions

Lecture 3: Chemical Speciation (use of speciation programs-Minteq2)

Section 3: Soil Solids

Lecture 1: Elemental Composition of Soil

Lecture 2: Soil Minerals
Secondary Minerals
Soil Organic Matter

Module II

Soil Chemical Reactions

Section 1: Ion Exchange

- Lecture 1: Concept & Source
Methods of CEC Measurements
Quantitative Description of Cation Exchange
A. Cation Exchange Equations
- Lecture 2: Quantitative Description of Cation Exchange
B. The exchange isotherm
Point of Zero Charge

Section 2: Adsorption Reactions

- Lecture 1: Introduction and definition
Surface functional groups
Surface complexes
Adsorption reactions
Diffuse double layer
A. Gouy Chapman Model
B. Stern Theory
- Lecture 2: Quantitative description of Adsorption
A. Adsorption Isotherms
Surface complexation models

Section 3: Precipitation and Dissolution Reactions

- Lecture 1: Precipitation – Dissolution Equilibria
Kinetics of mineral precipitation & dissolution
Precipitation in the soil environment
- Lecture 2: Unified phase diagram: construction & interpretation
Double function parameters
Co-precipitation of trace elements

Module III

Soil Chemical Reactions

Section 1: Soil Acidity

Lecture 1: Origin & Source
Classification of Soil Acidity
Aluminum Theory of Soil Acidity

Lecture 2: Buffer Ranges in Soils
Lime Requirements
Potential Hazards of Solid Acidification

Section 2: Oxidation Reduction Reactions

Lecture 1: Concept & Definitions
Thermodynamics Relationships
Redox Limits in Soils

Lecture 2: Oxidations-Reductions in Soils

- A. The source of electrons
- B. Electron acceptors in soil
- C. Important redox couples in soils

Section 3: Salt Affected Soils

Lecture 1: Sources of Salinity and Alkalinity
Carbonate Equilibria

- A. Sources of carbonates in the environment
- B. Carbonate species found in solution
- C. Equations to describe carbonate equilibrium
- D. Carbonate equilibrium diagram.

Equations to describe the $\text{CaCO}_3\text{-CO}_2\text{-H}_2\text{O}$ equilibria
Measures of salinity and alkalinity

Lecture 2: Clay Swelling and Dispersion
Effects of Salt degraded soils on plants
Reclamation of salt-degraded soils.