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
Time: 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://iss.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.


Supplemental Reading Materials (Posted on class website)

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:

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW</td>
<td>8 HW @ 20 pts each</td>
<td>160 points</td>
</tr>
<tr>
<td>Exams</td>
<td>3 exams @ 100 pts each</td>
<td>300 pts</td>
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<tr>
<td>Discussions</td>
<td></td>
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<tr>
<td>Bonus points</td>
<td>3 Exercises @ 5 pts each</td>
<td>15 pts</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>500 points + 15 bonus points</strong></td>
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Grade Scale:

A  \geq 450 points;  
A- \geq 440 points  
B+ \geq 425 points  
B  \geq 405 points  
B- \geq 395 points  
C+ \geq 380 points  
C  \geq 360 points  
C- \geq 335 points  
D+ \geq 315 points  
D  \geq 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/](http://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/](http://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/](http://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](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 CaCO$_3$-CO$_2$-H$_2$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.