

**Course Syllabus**  
**SWS 4451/5406**  
**Soil and Water Chemistry**  
**F'2016 3 Credits**

**Instructor:** G.A. O'Connor, Office: 3169 McCarty Hall A, Email: [gao@ufl.edu](mailto:gao@ufl.edu)

**Office hours:** Flexible, email for an appointment

**Course Overview:** The ability of soil to function as a medium for plant growth and/or waste disposal, a purifier of water, a determinant of contaminant fate and transport, etc. is inextricably tied to chemistry. Applying basic principles of chemistry to processes that occur commonly in soil/water systems is, thus, fundamental to understanding and optimizing soil functions. Successful approaches range from applied (empirical) to basic (theoretical) studies and conceptualizations. This course utilizes the full range of approaches, with emphasis on the soil solution and the various soil components and chemical processes influencing its chemistry.

**Course Objectives:** 1) Strengthen the student's understanding of basic chemical principles; 2) Teach students how to apply the principles to soil/water chemical processes; and 3) Demonstrate how chemical knowledge helps explain soil functions.

**Prerequisites:** Introduction to Soils (SWS 3022 or SWS 5050), General Chemistry (CHM 2046 or equivalent), or permission of the instructor.

**Course Format:** Three 50 minute lectures per week; M, W, and F; Period 5

**Frequency:** Yearly, Fall semester

**Textbook:** There is no required text for the course, but the recently revised (4<sup>th</sup> edition, 2015) text "Soil Chemistry" will serve as the primary resource for lectures. Other texts are available (see below), and will be utilized from time to time. The book "Chemical Equilibrium" by Bard is one of any number of texts covering chemistry basics that can be consulted.

**See also** <http://www.khanacademy.org/> for excellent chemistry videos

1. Soil Chemistry, 2015 (4<sup>rd</sup> Edition), D. G. Strawn, H.L. Bohn, and G.A. O'Connor. [SLO] Wiley Blackwell publisher – on reserve at Marston and E-book available through ARES]
2. Reading Supplements from "Chemistry of Natural Waters", course notes prepared by Dr. Dave Parker, Retired Prof Soil Chemistry, UC, Riverside, CA. Distributed by O'Connor.
3. Soil and Water Chemistry: An Integrative Approach, 2015 (2<sup>nd</sup> edition), Michael E. Essington, University of Tennessee, CRC Press – on reserve at Marston [MEE]
4. Chemical Equilibrium, 1966, by A.J. Bard [Harper & Row Publishers]
5. Environmental Soil Chemistry, 2003 (2<sup>nd</sup> Edition), D.L. Sparks, Academic Press – available as an e-book through ARES. [DLS]

**Software:** Students may be required to download and install a free version of Visual MINTEQ ver 3.0 for use in this course: <http://www2.lwr.kth.se/english/OurSoftWare/Vminteq/index.html>

### **Student Responsibilities:**

1. Study assigned readings in anticipation of lecture coverage
2. Actively participate in class discussions. **Class attendance and engagement is strongly recommended** (and rewarded – see below)
3. Demonstrate mastery of presented material by passing written examinations and successfully completing assigned homework assignments.
4. Demonstrate common courtesy by ensuring that cell phones and other electronic devices are turned off, arriving to class on time, and removing any personal trash.

### **Evaluation of Students:**

1. Two hour examinations, each 100 points (undergrads), 125 points (grads), and a comprehensive final, 200 points (undergraduates), 250 points (grads) will be given.

**Make up exams are rarely authorized and must be medically justified and authenticated.**

2. Homework assignments will be assigned regularly, and will be graded (total value 100 points). Unless otherwise stated, all assignments must be submitted in class on the due date. Late homework assignments are penalized 20% for each 24 hour period (or portion, thereof) after the beginning of class on the due date.
3. Graduate students are also required (and undergraduates offered the opportunity) to complete an extra assignment (100 points total value) consisting of additional (and more advanced) homework assignments (approximately, weekly).

### **Grading Scale:**

Course grades are determined by summing all scores, dividing by the maximum score possible (500 or 600 points for undergraduates and 700 points for graduates), and multiplying by 100. Letter grades are assigned as follows: 100-92% = A, 91-90% = A-, 89-87% = B+, 86-82 = B, 81-79% = B-, 78-75% = C+, 74-70% = C, 69-65% = D+, 64-60% = D.  $\leq 59$  = F.

The instructor reserves the right to **add 0-5 points to the final percentage score** based on his subjective evaluation of student interest, meaningful class participation, and overall dedication to the course. **Regular communication (appointments) with the instructor is strongly encouraged.** [For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.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*



**TOPIC OUTLINE**

<b><u>TOPIC</u></b>	<b><u>TEXT &amp; SUPPLEMENTS</u></b>	<b><u>#s LECTURES*</u></b>
<b>Course mechanics</b>	Syllabus	1 = 8/22
<b>Introduction/Overview</b> Soil chemistry and soil functions, Elemental properties Basic water quality	SBO Ch 1, 2 & 3 Parker supplement 1  (MEE Ch 1; DLS Ch 1)	4 = 8/24, 8/26, 8/29, 8/31
<b>Labor Day, No Class 9/5</b>		
<b>Soil and Water Chemistry</b> Chemical equilibria Ion hydration/hydrolysis Chemical activity Speciation Solubility	SBO Ch 4 Parker Supplements 2 & 3  (MEE Ch 5; DLS Ch 4)	10 = 9/2, 9/7, 9/9, 9/12 9/14, 9/16, 9/19 9/21, 9/23, 9/26
<b>Exam # 1, 9/28</b>		
<b>Soil Solid Phases</b> Weathering Soil clay mineralogy Organic solids Surface properties	SBO Ch 6 – 9   (MEE Ch 2-3, and 6; DLS Ch 2-3)	9 = 9/30, 10/3, 10/5, 10/7, 10/10, 10/12, 10/17, 10/19, 10/21
<b>Home-Coming, No Class 10/14</b>		
<b>Sorption Phenomena</b> Cation exchange Diffuse double layer Organics retention Sorption models	SBO Ch 10 & 11 Parker Supplement 9  (MEE Ch 8-9; DLS Ch 5-6)	9 = 10/24, 10/26, 10/28 10/31, 11/2, 11/4, 11/7, 11/9, 11/14
<b>Veteran's Day, No Class 11/11</b>		
<b>Exam # 2, 11/16</b>		

<b>Chemistry of Acid Soils</b>	SBO Ch 12	11/18, 11/21, 11/28 (1/2)
Characterization		
Impacts		
Remediation	(MEE Ch 10; DLS Ch 9)	

**Thanksgiving Break, No Class 11/23-11/25**

<b>Chemistry of Saline and Sodic Soils/Waters</b>	SBO Ch 13	11/28 (1/2), 11/30, 12/2
Characteristics		
Soil impacts	(MEE Ch 11; DLS Ch 10)	
Reclamation/management		
<b>Redox Chemistry of Soils</b>	SBO Ch 5	12/5, 12/7
Redox potentials		
Eh vs pH and pe vs pH	(MEE Ch 7; DLS Ch 8)	
Applications		

**Last day of classes 12/7**

**Final Exam, 12/14 @ 3 pm**

\* **Approximate** number of lectures and dates; topics towards the end of the outline, in particular, may not be covered in the detail indicated, and the order and extent of topic coverage may change.