Soil Science 322 – Physical Principles of Soil and Water Management (3 Credits)

Spring 2020

When: From Jan 21 to May 1, Tuesday and Thursday 9:30 AM – 10: 45 AM

Where: Room 357 Soil Science Building

Instructor: Dr. Jingyi Huang (jhuang426@wisc.edu)

Office hours: By appointment

Materials:

Soil Physics (Jury and Horton, 2004, 6th edition) or Principle of Soil Physics (Lal and Shukla, 2019, 1st edition)

Prerequisite(s): a course in Physics (103, 201, 207 or 247)

Breadths: P - Physical Science

Course description:

Management of soil and water resources relies on fundamental understanding of soil physical properties and processes, and how they interact with other environmental and biogeochemical processes across spatial and temporal scales. In this course, we will explore various physical properties and models developed to characterize the movement of water, heat, gas, and solutes in soils and apply these principles to manage soil resources for agricultural production, environmental monitoring, and ecological modeling.

The course consists of lectures and discussions. The lectures mainly focus on explaining soil physical properties and models as described in the textbooks by Jury and Horton (2004) or Lal and Shukla (2019). Real-world examples will be provided to demonstrate the use of these principles for management of soil and water resources related to soil quality, water conservation, irrigation management, energy conversation in soil, soil aeration, management of agricultural and industrial contaminants in soils. In addition, special topics will be discussed in the class to introduce the use of modern ground-based proximal soil sensors (https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054256) in the field to measure and monitor soil water resources and the application of digital soil mapping in soil and environmental studies (https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=stelprdb1254424).

In total, five discussion classes (tutorials) will be given. In each class, problem sets will be provided to facilitate the understanding of the lectures. Group discussion will be used to evaluate the main contributions and limitations of selected articles related to the course. The course schedule is provided at the end of this syllabus.

How the credit hours are met:

This class meets for two 75-minute class periods each week and expects that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about 3 hours out of classroom for every class period.

University of Wisconsin-Madison — Syllabus
SOIL SCI 322 — Physical Principles of Soil and Water Management

Learning outcomes:

After this course,

1. You should be able to explain the concepts of the main soil physical properties that are used in this course to describe the characteristics of soil solid, liquid, and gas phases.
2. You should be able to explain the implications of main models used in the course to describe the transport of water, heat, gas, and solutes in soils.
3. You should be able to summarize the main management practices related to soil solid, water, temperature, gas, solutes, and various agricultural and industrial contaminants.
4. You should be able to compare the advantages and disadvantages of the main proximal soil sensors discussed in this course.
5. You should be able to critically evaluate the scientific articles in soil and water management.
6. You should be able to prepare and present a scientific poster.

Exams and Grading Rubric

In this course, you need to complete five tutorial assignments, one three-min poster competition, one mid-term exam, and one final exam.

1. Tutorial assignment (40%):
   Five tutorial assignments will be provided along with the tutorial notes, each of which accounts for 8 points. Each assignment consists of four calculation-based problems (2 points each). You can work with other students on the assignments. You need to write down your solution process clearly on separate pieces of paper and turn them in at the next tutorial class. A penalty of 10% will be applied for late submission of the assignments.
   You will be marked 75% for the solution process and 25% for the final results. You are allowed to rework on the problem sets and resubmit your assignments within one week when the assignments are returned to you. If the second attempt is correct, you will get 90% of the points for the problems.
2. 3-min poster competition (20%):
   The 3-min poster competition accounts for 20 points and will be held in the class in Room 357, Soil Science Building, in Week 6. You need to prepare (electronically) and present a scientific poster to the peer students. You will be randomly assigned the topics of the poster presentation 3 weeks before the competition. Templates of the posters will be provided but you are encouraged to design your own poster. After each poster presentation, there is a Q&A session for questions. The other students can ask the presenter one question related to the talk and the presenter will have one minute to respond to the question. Each presenter will be evaluated by other students based on three criteria, namely, the organization of the poster (40%), clarity of the talk (40%), and the response to the questions (20%). The median value of the scores given by other students will be used as the final score of the presenter.
3. Mid-term (20%) and final (20%) exams:
   Both the mid-term exam and final exam account for 20 points. Each exam includes ten 1-point multiple-choice questions based on the basic concepts in the lectures and two calculation-based problems (5 points each). You need to use the models and equations taught in the lectures to solve the problems. Both exams are closed-book exams, but you are allowed to bring your calculators and five double-sided cheat sheets.

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Note: The two calculation problems from the mid-term and final exams are different for undergraduate and graduate students.

The final scores will be converted to letter grades by the instructor using the following scales:

A 90–100	B 80–85	D 60–70
AB 85–90	C 70–80	F <60

The instructor reserves the right to adjust the point-to-grade scheme to the advantage of the class and to add fractional points based on extraordinary effort to avoid straddling a grade boundary.

Attendance

If you will miss a class, inform the professor by email in advance, and arrange with another student in the class to get notes. Lecture slides will be posted online in advance, but they are often hard to understand without the interpretation of the instructor. Furthermore, most of the tips for deriving the physical models and solving the problem sets will be taught in the tutorial classes. If you miss some of these classes, you will probably need to spend much more time on the assignments and the exams. However, if you have a conflict with an exam day, let the professor know more than one week before, and we will arrange for you to take the exam early.

Academic integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

Accommodations for students with disabilities

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA."
http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

Diversity & inclusion

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu/

Course Schedule

Week	Tuesday	Thursday
1	Introduction	Ch1.1 Soil minerals and organic matter: the skeleton, flesh, and blood of soil
2	Ch1.2 Management of soil structure: enhancing food security and mitigating climate change	Ch2.1 Soil water content and energy status
3	Ch2.2 Soil water conservation and management of water-repellent soils	**D1**
4	Ch3.1 Water movement in soil columns	Ch3.2 Water flow under field conditions
5	Special topics: Management of soil erosion: digital soil mapping	Special topics: Proximal soil sensing
6	**D2**	3 min Presentation (Proximal Soil Sensing)
7	Exam Review	Mid-Term Exam
8	Ch4.1 Soil-Atmospheric Energy Balance	Ch4.2 Soil thermal properties and heat flow in soil
9	Spring Recess	Spring Recess
10	Ch4.3 Management of soil temperature for agro-ecosystem	**D3**
11	Ch5.1 Soil gas composition and soil aeration	Ch5.2 Management of soil aeration and volatile pollutants in soil
12	**D4**	Ch6.1 Chemical transport in soil
13	Ch6.2 Management of agrochemical pollution in soil	Ch6.3 Management of soil salinity and sodicity
14	Ch6.4 Management of heavy metal contamination in soil	**D5**
15	Exam Review	Exam Review
16		Final Exam

Note: black (non-bold), theoretical lecture classes; green, discussion classes (sample problems, literature discussion, and exam reviews); yellow, spring recessions; blue, poster presentation competition and mid-term/final exams.

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