

ENVIRONMENTAL SOIL PHYSICS

ENR 5261 Spring 2022

Course Information

- **Course times and location:**
 - **Online Lectures:** Mondays and Wednesdays, 10:20 a.m. – 11:15 a.m.
 - **Online Lab:** Thursdays 12:45 p.m. – 2:45 p.m.
- **Credit hours:** 3
- **Mode of delivery:** Distance Learning

Instructors

- **Name:** Rattan Lal
- **Email:** lal.1@osu.edu
- **Phone Number:** 614-292-9069
- **Office location:** 422B Kottman Hall
- **Office hours:** Mondays 1:00 p.m. – 2:00 p.m. or by appointment
- **Preferred means of communication:**
 - My preferred method of communication for questions is **email**.
 - My class-wide communications will be sent through the Announcements tool in CarmenCanvas. Please check your [notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to be sure you receive these messages.

Teaching Assistant

- **Name:** Umesh Acharya
- **Email:** acharya.112@osu.edu
- **Lab/Recitation times:** Thursdays 12:45 p.m. – 2:45 p.m.



Course Prerequisites

There are no course prerequisites.

Course Description

The course is designed for undergraduate and graduate students interested in learning basic soil physics and its applications to environment quality and sustainable use of natural resources. The syllabus meets the curriculum needs of students in Soil Sciences, Earth Sciences, Hydrology, Soil Mechanics, Natural Resources, Agricultural Engineering, Horticulture and Crop Sciences, Forestry, Restoration Ecology, and Environmental Sciences.

Learning Outcomes

After completion of this course, students will gain working knowledge of soil physical properties and how to manage them to optimize crop growth and minimize environmental problems. Through field and laboratory practical demonstrations and homework assignments, the student will learn methods of evaluating soil physical properties.

The practical skills to be demonstrated will include the following:

- Assessment of soil compaction and crusting
- Particle size distribution and its measurement
- Soil structure, porosity and pore-size distribution
- Plant-available water reserves
- Water movement within soil and the overland flow
- Soil temperature regime, specific heat
- Aeration, gaseous diffusion and composition of soil air
- Greenhouse effect and global warming
- Plant-water relations, drought stress
- Soil erosion process and erodibility
- Soil physical quality and plant growth

How This Course Works

Mode of delivery: Lecture and lab for this course is 100% virtual and online.

There is a required synchronous (real time) session in Zoom each week on Mondays and Wednesdays from 10:20-11:15 a.m and on Thursdays 12:45-2:45 p.m. for lab. Attendance will be taken at each session, and each student will be expected to actively participate in lecture discussions and labs.

The rest of your work is found in Carmen and can be completed around your own schedule during the week.

Pace of online activities: This course is divided into **weekly modules** with reading materials that are released one week ahead of time. Students are expected to keep pace with weekly deadlines but may schedule their efforts freely within that time frame.

Credit hours and work expectations: This is a **3 credit-hour course**. According to [Ohio State bylaws on instruction](http://go.osu.edu/credithours) (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading, studying, editing notes, and assignment preparation, for example) to receive a grade of C average.

Attendance and participation requirements: Because this is an online course, your attendance is based on your online activity and participation. Research shows regular participation is one of the highest predictors of success. With that in mind, I have the following expectations for everyone's participation:

- **Weekly Zoom lectures and laboratory: Required**
You are expected to attend weekly lectures and actively participate in virtual online laboratory sessions. If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible*.
- **Participating in online activities for attendance: At least once per week**
You are expected to log in to the course in Carmen every week to access readings and assignments. During most weeks you will probably log in many times.
- **Zoom meetings and office hours: Optional**
My office hours are optional. I will post recordings of synchronous sessions for those who cannot attend.



Course Materials, Fees and Technologies

Required Reading Materials

- Lal, R. and M.K. Shukla (2004) Principles of Soil Physics. Marcel Dekker, New York, 716 pp.

Recommended Reading Materials

- H. Don Scott (2000) Soil Physics: Agricultural and Environmental Applications. Iowa State Univ. Press, 421 pp.
- D. Hillel (1998) Environmental Soil Physics, Academic Press, 770 pp.
- Baver, L.D., W.H. Gardner and W.R. Gardner (1972) Soil Physics. John Wiley & Sons, Inc., New York.
- Rose, C.W. (1966) Agricultural Physics. Pergemon Press, New York.
- Khonke, Helmut (1968) Soil Physics. McGraw Hill Book Co., New York.
- Black, C.A. (Editor-in-Chief) (1986) Methods of Soil Analysis. Part I. ASA, Madison, WI.
- Marshall, T.J., J.W. Holmes, and C.W. Rose (1996) Soil Physics. Third edition, Cambridge University Press, 453 pp.
- Taylor, S.A. and G.L. Ashcroft (1972) Physical edaphology. W.H. Freeman and Co.
- Hanks, R.J. and G.L. Ashcroft (1980) Applied Soil Physics. Springer-Verlag.
- Hillel, D. (1980) Applications of Soil Physics. Academic Press, 385 pp.
- Hillel, D. (1982) Introduction to Soil Physics. Academic Press, 364 pp.
- Ellis, S. and A. Mellor (1995) Soils and Environment. Routledge, London, 364 pp.

Required Equipment

- **Computer:** current Mac (MacOS) or PC (Windows 10) with high-speed internet connection
- **Webcam:** built-in or external webcam, fully installed and tested
- **Microphone:** built-in laptop or tablet mic or external microphone
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

If you do not have access to the technology you need to succeed in this class, review options for [technology and internet access](https://go.osu.edu/student-tech-access) (go.osu.edu/student-tech-access).

Required Software

Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365. Visit the [installing Office 365](https://go.osu.edu/office365help) (go.osu.edu/office365help) help article for full instructions.

CarmenCanvas Access

You will need to use [BuckeyePass](https://buckeyepass.osu.edu) (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](https://go.osu.edu/add-device) (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes, good for 365 days, that can each be used once.
- [Install the Duo Mobile application](https://go.osu.edu/install-duo) (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at [614-688-4357 \(HELP\)](tel:614-688-4357) and IT support staff will work out a solution with you.

Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- [Navigating CarmenCanvas](https://go.osu.edu/canvasstudent) (go.osu.edu/canvasstudent)
- [CarmenZoom virtual meetings](https://go.osu.edu/zoom-meetings) (go.osu.edu/zoom-meetings)
- [Recording a slide presentation with audio narration and recording, editing and uploading video](https://go.osu.edu/video-assignment-guide) (go.osu.edu/video-assignment-guide)

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat:** go.osu.edu/it
- **Phone:** [614-688-4357 \(HELP\)](tel:614-688-4357)
- **Email:** servicedesk@osu.edu



Grading and Faculty Response

How Your Grade is Calculated

Assignment Category	Points
Homework 1	10 (5% of grade)
Lab 1 report	10 (5% of grade)
Homework 2	10 (5% of grade)
Lab 2 report	10 (5% of grade)
Homework 3	10 (5% of grade)
Lab 3 report	10 (5% of grade)
Homework 4	10 (5% of grade)
Lab 4 report	10 (5% of grade)
Homework Set 5	10 (5% of grade)
Lab 5 report	10 (5% of grade)
Homework Set 6	10 (5% of grade)
Lab 6 report	10 (5% of grade)
Homework Set 7	10 (5% of grade)
Lab 7 report	10 (5% of grade)
Homework Set 8	10 (5% of grade)
Lab 8 report	10 (5% of grade)



Homework Set 9	10 (5% of grade)
Lab 9 report	10 (5% of grade)
Homework Set 10	10 (5% of grade)
Lab 10 report	10 (5% of grade)

See [Course Schedule](#) for due dates.

Descriptions of Major Course Assignments

Homework and Lab Reports Assignments

Description: Homework consists of problems sets, and results will be discussed the day they are due, usually on Mondays, as marked in the class schedule. The practicals demonstrated in laboratory will be synchronized with the weekly lecture, and lab reports will be assigned and due on Thursdays, according to the class schedule starting on page 14.

Academic integrity and collaboration: Your written assignments, including homework sets and practical sets, should be your own original work. In formal assignments, you should follow Chicago style to cite the ideas and words of any research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in but no one else should revise or rewrite your work.

Late Assignments

Please refer to Carmen for due dates. Due dates are set to help you stay on pace and to allow timely feedback that will help you complete subsequent assignments. Students are expected to make every effort to submit assignments on time. Please contact the instructors as soon as possible if an assignment will be late. Three or more missed classes may require documentation from a doctor or other source.

Instructor Feedback and Response Time

I am providing the following list to give you an idea of my intended availability throughout the course. Remember that you can call [614-688-4357 \(HELP\)](tel:614-688-4357) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact me first through my Ohio State email address. I will reply to emails within **24 hours on days when class is in session at the university**.

- **Class announcements:** I will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check [your notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Discussion board:** I will check and reply to messages in the discussion boards once mid-week and once at the end of the week.
- **Grading and feedback:** For assignments submitted before the due date, I will try to provide feedback and grades within **seven days**. Assignments submitted after the due date may have reduced feedback and grades may take longer to be posted.

Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Other Course Policies

Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

A significant component of our interactions in this class will occur through Zoom videoconferencing. Because this mode of discussion has benefits and challenges that differ from in-person class sessions, I want to share my expectations for how we will meet and communicate:

- **Technical Issues:** If you encounter a technical issue with Zoom during a session, first make sure you are using the latest version of Zoom. Next, contact the IT Service Desk at go.osu.edu/it or 614-688-4357(HELP). If issues continue, contact me after the session to learn how to make up for the missed content either via a recording or other means. I will not be able to address technical issues during a live session.
- **Preparation:** Come to the session having completed any readings or pre-work and be ready to have open, civil, and supportive discussions in video and chat spaces. I ask that you update your Zoom profile with your preferred name and add a picture with your face.
- **Participation:** At the start of our sessions, I will share specific expectations for how to use the chat, how to interact, and how to raise questions or concerns as we go. If you are unsure about expectations or are unsure about raising a question, please follow up with me afterward to make sure your questions are answered. Plan to be present during the entire class session as much as you are able. For some activities, I may ask you to share your faces on camera so that we can see each other and connect. Please feel encouraged to use a non-distracting [virtual background](#). Many students and instructors prefer not to share their remote spaces for a variety of reasons. Mute your microphone when others are talking to minimize background noise in the meeting.

If you have any concerns about participating in class over Zoom in this way, please let me know. My goal is to create a safe environment where we can benefit from seeing each other and connecting, but I want to prioritize your safety and well-being.

Recordings: I will be recording our meetings for the benefit of students who may need to be absent. These links will only be shared with students in our class, and only when a student contacts me to make this arrangement.

Your interaction with students and their interactions with each other are crucial components of students' success in an online class. Customize this section with statements that capture your expectations in the context of the particular technology media where you and students will be interacting.

These are additional guidelines for class communication and discussions:

- **Writing style:** Students should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.
- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online. I will provide specific guidance for discussions on controversial or personal topics.
- **Citing your sources:** When we have academic discussions, please cite your sources to back up what you say. For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.
- **Backing up your work:** Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.
- **Synchronous sessions:** During our Zoom sessions I ask you to use your real name and a clear photo of your face in your Carmen profile. During our full-group lecture time, you may turn your camera off if you choose. When in breakout rooms or other small-group discussions, having cameras and mics on as often as possible will help you get the most out of activities. You are always welcome to use the [free, Ohio State themed virtual backgrounds](http://www.osu.edu/downloads/zoom-backgrounds.html) (www.osu.edu/downloads/zoom-backgrounds.html). Remember that Zoom and the Zoom chat are our classroom space where respectful interactions are expected.

Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this online class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](http://studentconduct.osu.edu) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct,

so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course. Materials may be given through a link or reference so that students may access them securely through the library.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Office of Institutional Equity:

1. Online reporting form at equity.osu.edu,
2. Call 614-247-5838 or TTY 614-688-8605,
3. Or Email equity@osu.edu

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Office of Institutional Equity to ensure the university can take appropriate action:

- All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.
- The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member."

This course adheres to The Principles of Community adopted by the College of Food, Agricultural, and Environmental Sciences. These principles are located on the Carmen site for this course; and can also be found at <https://go.osu.edu/principlesofcommunity>. For additional information on Diversity, Equity, and Inclusion in CFAES, contact the CFAES Office for Diversity, Equity, and Inclusion (<https://equityandinclusion.cfaes.ohio-state.edu/>). If you have been a victim of or a witness to a bias incident, you can report it online and anonymously (if you choose) at <https://studentlife.osu.edu/bias/report-a-bias-incident.aspx>.

Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, [on-demand mental health resources](https://go.osu.edu/ccsondemand) (go.osu.edu/ccsondemand) are available. You can reach an on-call counselor when CCS is closed at [614- 292-5766](tel:6142925766). **24-hour emergency help** is available through the [National Suicide Prevention Lifeline website](https://suicidepreventionlifeline.org) (suicidepreventionlifeline.org) or by calling [1-800-273-8255\(TALK\)](tel:18002738255). [The Ohio State Wellness app](https://go.osu.edu/wellnessapp) (go.osu.edu/wellnessapp) is also a great resource.

Accessibility Accommodations for Students with Disabilities

Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with [Student Life Disability Services \(SLDS\)](#). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's [request process](#), managed by Student Life Disability Services.

Disability Services Contact Information

- Phone: [614-292-3307](tel:614-292-3307)
- Website: slds.osu.edu
- Email: slds@osu.edu
- In person: [Baker Hall 098, 113 W. 12th Avenue](#)

Accessibility of Course Technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations as early as possible.

- [CarmenCanvas accessibility](http://go.osu.edu/canvas-accessibility) (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- [CarmenZoom accessibility](http://go.osu.edu/zoom-accessibility) (go.osu.edu/zoom-accessibility)

Course Schedule

Refer to the CarmenCanvas course for up-to-date due dates.

Week	Day	Topics	Assignments and Due Dates
1	Jan 10 M	i. Definition of soil physical properties and processes	Reading: Chapters 1 & 2 (p. 1 – 31)
		ii. Importance of soil physics to the environment and natural resources	Assigned: Homework 1 Mass-volume relationship, soils and environment, Chapter 2, Problems 1, 3 (p. 29 – 30)
	iii. Mass-volume relationship		
Jan 12 W	i. Particle size distribution ii. Different systems of particle classification iii. Stoke's law	Reading: Chapter 3 (p. 34 – 44)	
Jan 13 Th	Lab 1: Soil bulk density by core method, demonstration of clod method, and explanation of other methods	Assigned: Lab 1 report	
Jan 17 M	Martin Luther King Day No Class		
2	Jan 19 W	i. Soil constituents, organic and inorganic ii. Predominant minerals iii. Composition of organic fraction	DUE: Homework 1 at 5:00 PM
			Reading: Chapter 3 (p. 77 – 86)
	Assigned: Homework 2 Stoke's Law and surface area, Chapter 3, Problems 1, 3, 16		
Jan 20 Th	Lab 2: Hydrometer analyses, demonstration of the Pipet method	DUE: Lab 1 report at 5:00 PM	
		Assigned: Lab 2 report	

3	Jan 24 M	<ul style="list-style-type: none"> i. Particle shape ii. Surface area iii. Packing arrangement 	Reading: Chapter 3 (p. 44 – 53, 53 – 77)
	Jan 26 W	<ul style="list-style-type: none"> i. Properties of clay fraction ii. Surface charge, Zeta potential 	Reading: Chapter 3 (p. 52 – 73)
	Jan 27 Th	Lab 3: Particle Density	DUE: Lab 2 report at 5:00 PM Assigned: Lab 3 report
4	Jan 31 M	Particle density	DUE: Homework 2 at 5:00 PM
	Feb 2 W	<ul style="list-style-type: none"> i. Soil structure ii. Aggregation iii. Formation of organo-mineral complexes iv. Assessment of soil structure 	Reading: Chapter 4 (p. 93 – 140)
	Feb 3 Th	Lab 4: Aggregation and tensile strength	DUE: Lab 3 report at 5:00 PM Assigned: Lab 4 report
5	Feb 7 M	Properties of water <ul style="list-style-type: none"> i. Surface tension ii. Viscosity iii. Contact angle iv. Capillarity 	Reading: Chapter 9 (p. 255 – 286) Assigned: Homework 3 Capillarity, pore size distribution, Chapter 5, Problems 1 (one temp. only), 4 (p. 161)
	Feb 9 W	<ul style="list-style-type: none"> i. Porosity and pore size distribution ii. Classification of pores iii. Measurement of pore size 	Reading: Chapter 5 (p. 149 – 161)
	Feb 10 Th	Lab 5: Atterberg's Limits	DUE: Lab 4 report at 5:00 PM Assigned: Lab 5 report

6	Feb 14 M	Applications of soil structure i. Crusting ii. Surface seal formation	Reading: Chapter 6 (p. 165 – 185)
	Feb 16 W	i. Soil strength ii. Stress/strain	Reading: Chapter 7 (p. 189 – 205)
	Feb 17 Th	Lab 6: Tension table and p^F curve	DUE: Lab 5 report at 5:00 PM Assigned: Lab 6 report
7	Feb 21 M	i. Soil compaction and consolidation ii. Boussinesq equation iii. Machinery and compaction iv. Root growth	Reading: Chapter 7 (p. 205 – 224)
	Feb 23 W	i. Consistency ii. Plasticity iii. Atterberg's limits	Reading: Chapter 8 (p. 231 – 251)
	Feb 24 Th	Lab 7: Laboratory on p^F curve	
8	Feb 28 M	i. Hydrologic cycle ii. Soil moisture content iii. Soil water potential	Reading: Chapter 10 (p. 287 – 315) Assigned: Homework 4 Moisture content and potential Chapter 10 (pgs. 314 – 315), Problems 1, 2; Chapter 11 (pg. 351), Problems 10
	Mar 2 W	i. Soil moisture characteristic curves ii. Plant-available water iii. Soil water potential measurement	Reading: Chapter 11 (p. 321 – 341)
	Mar 3 Th	Lab 8: Saturated hydraulic conductivity	DUE: Lab 6 report at 5:00 PM Reading: Chapter 12 (p. 361 – 377)

9	Mar 7 M	i. Water movement in saturated soil ii. Different forms of Darcy's Law	DUE: Homework 4 at 5:00 PM Reading: Chapter 12 (p. 341 – 352) Assigned: Homework 5 Chapter 12, Problems 3, 6 (p. 377)
	Mar 9 W	i. Water movement in saturated soil: numerical examples	Reading: Chapter 12 (p. 355 – 361)
	Mar 10 Th	Lab 9: Water infiltration	DUE: Lab 7 report 5:00 PM Assigned: Lab 8 report
10	Mar 14	Spring Break No Class	
11	Mar 21 M	Methods of measuring K_s : merits and limitations	DUE: Homework 5 at 5:00 PM
	Mar 23 W	Water movement in unsaturated soil: (i) K_θ , (ii) D_θ	Reading: Chapter 13 (p. 379 – 402) Reading: Chapter 12 (p. 405 – 412)
	Mar 24 Th	Lab 10: Gas diffusivity	DUE: Lab 8 report at 5:00 PM Assigned: Lab 9 report Assigned: Homework 6 Chapter 14, Problems 1, 2, 3 (p. 434 – 435)
11	Mar 28 M	i. Models of infiltration ii. Calculations of S, A, I	Reading: Chapter 14 (p. 412 – 434)
	Mar 30 W	i. Water movement in vapor state diffusion	Reading: Chapter 15 (p. 439 – 446)
	Mar 31 Th	Lab 11: Field measurements of aeration using PAS and static chamber	DUE: Lab 9 report at 5:00 PM Assigned: Homework 7 Chapter 15, Problems 1 – 2 (p. 463)



12	Apr 4 M	i. Soil evaporation and its management	DUE: Homework 6 at 5:00 PM Reading: Chapter 15 (p. 446 – 460)
	Apr 6 W	i. Soil aeration ii. Air capacity iii. Composition of soil air	DUE: Homework 7 at 5:00 PM Reading: Chapter 18 (p. 557 – 569) Assigned: Homework 8 Soil air, Chapter 18, Problems 1, 3, 5, 7 (p. 594)
	Apr 7 Th	Lab 12: Soil evaporation measurement	Assigned: Lab 10 report
13	Apr 11 M	i. Aeration ii. Gaseous exchange	Reading: Chapter 18 (p. 569 – 575)
	Apr 13 W	i. Mass flow ii. Diffusion	Reading: Chapter 18 (p. 575 – 590)
	Apr 14 Th	Lab 13: ODR and gaseous	Assigned: Homework 9 Calculate the weight of CO ₂ in the atmosphere for CO ₂ concentration of 400 ppm and 550 ppm
14	Apr 18 M	i. Soil temperature regime ii. Heat capacity iii. Thermal conductivity	DUE: Homework 8 at 5:00 PM Reading: Chapter 17 (p. 515 – 530) Assigned: Homework 10 Soil temperature, Chapter 17, Problems 1, 3, 5
	Apr 20 W	i. Heat transport in soil ii. Modeling soil temperature	Reading: Chapter 17 (p. 531 – 545)
	Apr 21 Th	Lab 14: Soil temperature measurement	DUE: Lab 10 report at 5:00 PM
15	Apr 25 M	Soil salinity	DUE: Homework 9 at 5:00 PM DUE: Homework 10 at 5:00 PM

