

ENVIRONMENTAL SOIL PHYSICS

ENR 5261
PHYSICS 5261

Course Information

- **Course times and location:**
 - **Lecture:** Mondays and Wednesdays, 10:20 a.m. – 11:15 a.m., Kottman Hall TBD
 - **Lab:** Thursdays 12:45 p.m. – 2:45 p.m.
- **Credit hours:** 3
- **Mode of delivery:** In person

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.
- **Name:** Nandini Trivedi
- **Email:** Trivedi.15@osu.edu
- **Phone Number:** 614-746-9263
- **Office location:** Physics Research Bldg, 2026
- **Office hours:** TBD, 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

Course Prerequisites

There are no course prerequisites.

Course Description

Principally involves the state and transport of water, heat and gas within soil, and the associated soil physical properties.

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. Cross-listed with Physics 5261.

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 meet in person.

Sessions will meet 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. While attendance and participation are not graded components of this course, engagement is necessary to be successful.

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

Pace of 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 4 hours per week of time spent on direct instruction and laboratory activities (instructor content and Carmen activities, for example) in addition to 5 hours of homework (reading, studying, editing notes, and assignment preparation, for example) to receive a grade of C average.

Attendance and participation requirements: 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 lectures and laboratory: Required**
You are expected to attend weekly lectures and actively participate in 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*.
- **Carmen use: 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.
- **Office hours: Optional**
Our office hours are optional.

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

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 5	10 (5% of grade)
Lab 5 report	10 (5% of grade)
Homework 6	10 (5% of grade)
Lab 6 report	10 (5% of grade)
Homework 7	10 (5% of grade)
Lab 7 report	10 (5% of grade)
Homework 8	10 (5% of grade)
Lab 8 report	10 (5% of grade)

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

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

Undergraduate and graduate students will be held to the same standards and expectations in this course.

Descriptions of Major Course Assignments

Homework and Lab Report Assignments

Description: Homework consists of problems sets, and they are typically assigned on Mondays and due the following Monday, as marked in the class schedule. There are some weeks where the homework assignment schedule differs, so please pay close attention to the schedule detailed here and on Carmen. The demonstrations in laboratory will be synchronized with the weekly lecture, and corresponding lab reports will be assigned on Thursdays and due the following Thursday, according to the class schedule starting on page 14. Assignments will be submitted to the Carmen dropbox.

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 (see chicagomanualofstyle.org or OSU Libraries for Chicago Style resources - <https://guides.osu.edu/c.php?g=605168&p=4194384>) 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. Arrangements may be made if you are facing extenuating circumstances such as illness or an emergency. Documentation will be required.

Instructor Feedback and Response Time

We are 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.
- **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

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](#) (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."



Diversity Statement

The Ohio State University affirms the importance and value of diversity of people and ideas. We believe in creating equitable research opportunities for all students and to providing programs and curricula that allow our students to understand critical societal challenges from diverse perspectives and aspire to use research to promote sustainable solutions for all. We are committed to maintaining an inclusive community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among all members; and encourages each individual to strive to reach their own potential. The Ohio State University does not discriminate on the basis of age, ancestry, color, disability, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, race, religion, sex, gender, sexual orientation, pregnancy, protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment.

To learn more about diversity, equity, and inclusion and for opportunities to get involved, please visit:

- <https://odi.osu.edu/>
- <https://odi.osu.edu/racial-justice-resources>
- <https://odi.osu.edu/focus-on-racial-justice>
- <http://mcc.osu.edu/>

In addition, 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://equity.osu.edu/>.

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. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing.

If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting



ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th floor of the Younkin Success Center and 10th floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

For students in the College of Food, Agricultural, and Environmental Sciences, David Wirt, wirt.9@osu.edu, is the CFAES embedded mental health counselor on the Columbus campus. To contact David, please call 614-292-5766. Students should mention their affiliation with CFAES if interested in speaking directly with David.

Accessibility Accommodations for Students with Disabilities

Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. 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. 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. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 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](https://go.osu.edu/canvas-accessibility) (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- [CarmenZoom accessibility](https://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	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		
1	W	i. Particle size distribution ii. Different systems of particle classification iii. Stoke's law	Reading: Chapter 3 (p. 34 – 44)
	Th	Lab 1: Soil bulk density by core method, demonstration of clod method, and explanation of other methods	Assigned: Lab 1 report
2	M	Martin Luther King Day No Class	
	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
Th	Lab 2: Hydrometer analyses, demonstration of the Pipet method	DUE: Lab 1 report at 5:00 PM	
		Assigned: Lab 2 report	

3	M	<ul style="list-style-type: none"> i. Particle shape ii. Surface area iii. Packing arrangement 	Reading: Chapter 3 (p. 44 – 53, 53 – 77)
	W	<ul style="list-style-type: none"> i. Properties of clay fraction ii. Surface charge, Zeta potential 	Reading: Chapter 3 (p. 52 – 73)
	Th	Lab 3: Particle Density	DUE: Lab 2 report at 5:00 PM Assigned: Lab 3 report
4	M	Particle density	DUE: Homework 2 at 5:00 PM
	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)
	Th	Lab 4: Aggregation and tensile strength	DUE: Lab 3 report at 5:00 PM Assigned: Lab 4 report
5	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)
	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)
	Th	Lab 5: Atterberg's Limits	DUE: Lab 4 report at 5:00 PM Assigned: Lab 5 report



6	M	Applications of soil structure i. Crusting ii. Surface seal formation	DUE: Homework 3 at 5:00 PM
			Reading: Chapter 6 (p. 165 – 185)
	W	i. Soil strength ii. Stress/strain	Reading: Chapter 7 (p. 189 – 205)
	Th	Lab 6: Tension table and p^F curve	DUE: Lab 5 report at 5:00 PM
			Assigned: Lab 6 report
7	M	i. Soil compaction and consolidation ii. Boussinesq equation iii. Machinery and compaction iv. Root growth	Reading: Chapter 7 (p. 205 – 224)
	W	i. Consistency ii. Plasticity iii. Atterberg's limits	Reading: Chapter 8 (p. 231 – 251)
	Th	Lab 7: Laboratory on p^F curve	
8	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
	W	i. Soil moisture characteristic curves ii. Plant-available water iii. Soil water potential measurement	Reading: Chapter 11 (p. 321 – 341)
	Th	Lab 8: Saturated hydraulic conductivity	DUE: Lab 6 report at 5:00 PM
			Assigned: Lab 7 report
			Reading: Chapter 12 (p. 361 – 377)



9	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)
	W	i. Water movement in saturated soil: numerical examples	Reading: Chapter 12 (p. 355 – 361)
	Th	Lab 9: Water infiltration	DUE: Lab 7 report 5:00 PM Assigned: Lab 8 report
10	Spring Break No Class		
11	M	Methods of measuring K_s : merits and limitations	DUE: Homework 5 at 5:00 PM
	W	Water movement in unsaturated soil: (i) K_θ , (ii) D_θ	Reading: Chapter 13 (p. 379 – 402) Reading: Chapter 12 (p. 405 – 412)
	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	M	i. Models of infiltration ii. Calculations of S, A, I	Reading: Chapter 14 (p. 412 – 434)
	W	i. Water movement in vapor state diffusion	Reading: Chapter 15 (p. 439 – 446)
	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	M	i. Soil evaporation and its management	DUE: Homework 6 at 5:00 PM Reading: Chapter 15 (p. 446 – 460)
	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)
			Assigned: Lab 10 report
Th	Lab 12: Soil evaporation measurement		
13	M	i. Aeration ii. Gaseous exchange	Reading: Chapter 18 (p. 569 – 575)
	W	i. Mass flow ii. Diffusion	Reading: Chapter 18 (p. 575 – 590)
	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	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
			Reading: Chapter 17 (p. 531 – 545)
	Th	Lab 14: Soil temperature measurement	DUE: Lab 10 report at 5:00 PM
15	M	Soil salinity	DUE: Homework 9 at 5:00 PM DUE: Homework 10 at 5:00 PM