

## Soils 507 Soil Physics

Spring 2010, 3-4 credits

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Class: M W F 11:15 am – 12:05 pm. All class will be in 011 ASI  
***Optional lab with 4<sup>th</sup> credit will have a flexible schedule to be individually determined.***

Office Hours: M W F 1:30-2:30 pm, or by appointment.

Textbook: Hillel, D.J. 1998. *Environmental Soil Physics*. Academic Press, NY. (Free preview at [http://books.google.com/books?hl=en&lr=&id=tP\\_y5xRd0oC&oi=fnd&pg=PR19&dq=%22Hillel%22+%22Environmental+soil+physics%22+%22&ots=85-2IMtjzm&sig=-i-Qg-Y3T4RUNO-MLcYRQlgIY6w#v=onepage&q=&f=false](http://books.google.com/books?hl=en&lr=&id=tP_y5xRd0oC&oi=fnd&pg=PR19&dq=%22Hillel%22+%22Environmental+soil+physics%22+%22&ots=85-2IMtjzm&sig=-i-Qg-Y3T4RUNO-MLcYRQlgIY6w#v=onepage&q=&f=false))

Reference: Tindall, J.A., and J.R. Kunkel. 1999. *Unsaturated Zone Hydrology for Scientists and Engineers*. Prentice Hall, NJ. (The whole book is free at: [http://wwwbrr.cr.usgs.gov/projects/GW\\_Unsat/Unsat\\_Zone\\_Book/index.html](http://wwwbrr.cr.usgs.gov/projects/GW_Unsat/Unsat_Zone_Book/index.html) )

Grading: Grades will be based on 100% as distributed below. Breaks between letter grades will be at 90% (A), 80% (B), 70% (C), and 60% (D), with plus and minus grades as appropriate (A: 94-100, A-: 90-93, B+: 86-89, B: 83-85, B-: 80-82, C+: 76-79, C: 73-75, C-: 70-72, D+: 65-69, D: 60-64, F: <60). Final grades may be adjusted based on overall class performance.

• <b>Class research project</b>	<b>50%</b>
➤ Presentation & demo	25%
➤ Written report	25%
• <b>Homework</b>	<b>20%</b>
• <b>Quizzes (related to reading &amp; lecture)</b>	<b>10%</b>
• <b>Exams (a midterm and a final)</b>	<b>20%</b>
<b>TOTAL</b>	<b><u>100%</u></b>

### **One extra credit for Lab:**

A guided, **in-depth** study of a selected lab or field technique (actual hands-on work will be involved) OR a focused topic to be studied and comprehensively reviewed (with various techniques involved).

- **A final written report** **100%**

Further explanations of the above requirements and relevant guidelines will be provided in the 1<sup>st</sup> class. **Opportunities for bonus credits may arise throughout the semester.**

Attendance: **Regular attendance to classes is required.** Students who have to miss a class must provide a legitimate reason beforehand and will be self-responsible for missed class.

## Guidelines for Class Research Project

**Purpose:** Each student is expected to complete a *small* research paper in this course. The project is designed to give students an opportunity to identify and research *a concrete small topic or problem* related to soil physics and student's own research interest. The scope of the project should be equivalent to *a small scientific paper*, and should be reported accordingly. A written paper and an oral presentation will be required at the end of the class.

**Oral presentation:** Each student will be required to give a 10-12 minute presentation using PowerPoint (as if at a professional scientific meeting). A few minutes' question session will follow each presentation. **Graphics and tables are strongly suggested for effective, informative, and interesting presentation.** Oral presentation will be graded based on 1) *thoroughness in understanding* of the subject presented, 2) *clarity and effectiveness* of presentation, and 3) *response to questions* (correctness and thoroughness).

**Written paper:** No page limit (generally 15-30 typed pages). Must type in 1.5-spacing and submit a neatly written copy. **The paper should include important figures, maps, and/or tables. Any citation should also be included.** The report will be graded based on 1) *content* (thoroughness in the understanding and critical thinking of the chosen subject), 2) *clarity* (report format and writing skill), and 3) *creativity (anything new and innovative aspect is particularly encouraged, which often leads to bonus points)*.

### Suggested outlines of written paper (Required format):

- Cover page: Include the title of your project, your name, class, and date
- Abstract: A brief summary of your project, including objectives, methods used, and main results and conclusions
- Introduction: Background information, your project motivation, and your project objectives
- Materials & Methods (or equivalent if it is a comprehensive review)
- Results & Discussion (or equivalent if it is a comprehensive review)
- Conclusion: A few sentences highlighting the main findings of your project
- Reference: List of all references cited in your report

### Due dates:

- Research topic selection (including a brief justification and a work plan for completing the project) **Week 5**
- Oral presentation **Week 14-15**
- Final written paper **Week 16**

**Suggested Topics:** **Each topic must be approved by the instructor.** Please feel free to discuss your topic with the instructor as soon as possible. If not sure or if preferred, the instructor may assign you a topic. If possible, it is recommended that a graduate student select a topic that would showcase the linkage between soil physics and his/her own thesis research. By week 5, each student must firm up with his/her topic, and submit a brief justification of selected topic and a general work plan for completing the project by the end of the semester.

## Selected References and Learning Resources

### *Online books or resources:*

- Soil Science Society of America (SSSA) **Glossary of soil science terms:** <http://www.soils.org/sssagloss/>
- Online **USDA-NRCS books and standards:** <http://soils.usda.gov/technical/>
- USDA-NRCS Soils Online Resources: <http://soils.usda.gov/>
- Online soil surveys of the U.S.: [http://soils.usda.gov/survey/online\\_surveys/](http://soils.usda.gov/survey/online_surveys/)
- Online Official soil series description (OSD): <http://soils.usda.gov/technical/classification/osd/index.html>
- Keys to Soil Taxonomy: [http://soils.usda.gov/technical/classification/tax\\_keys/](http://soils.usda.gov/technical/classification/tax_keys/)
- World Reference Base (WRB): <http://www.fao.org/landandwater/agll/wrb/default.stm>
- European Soil Bureau: <http://eusoils.jrc.it/>
- **National Research Council books (Read online free!):** <http://books.nap.edu/>
- **Free ebooks** (Project Gutenberg Online Book Catalog): [http://www.gutenberg.org/wiki/Main\\_Page](http://www.gutenberg.org/wiki/Main_Page)
- Wikipedia – Free online encyclopedia: [http://en.wikipedia.org/wiki/Main\\_Page](http://en.wikipedia.org/wiki/Main_Page)

### *Online databases and literature search:*

- **ISI Web of Science:**  
<http://portal.isiknowledge.com/portal.cgi/portal.cgi?DestApp=WOS&Func=Frame&Init=Yes&SID=E157McpE61f7CC8eAB4>
- **Google Scholar:** [http://scholar.google.com/advanced\\_scholar\\_search?hl=en&lr=](http://scholar.google.com/advanced_scholar_search?hl=en&lr=)
- ScienceDirect: <http://www.sciencedirect.com/science>
- Journal Citation Reports (*JCR Web*): <http://scientific.thomson.com/products/jcr/>
- Subject collections of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America journals: <http://www.sci-journals.org/collections/>

### *Popular soil and water scientific journals:*

- Soil Science Society of America J.
- Soil Science
- Vadose Zone J.
- J. Environmental Quality
- Environmental Science & Technology
- J. Soil & Water Conservation
- J. Contaminated Soil
- Geoderma
- Catena
- Soil Tillage Research
- European J. Soil Science (J. Soil Science)
- Canadian J. Soil Science
- Australia J. Soil Res.
- Soil Science and Plant Analysis
- Hydrology and Earth System Sciences
- Water Resources Research
- J. of American Water Resources Association
- Water Research
- Hydrogeology
- J. Hydrology
- J. Contaminant Hydrology
- J. Environmental Engineering, ASCE
- Transactions of ASAE (American Society of Agricultural Engineers)
- Wetlands
- Ecological Modeling
- Ecology
- Geomorphology
- Land Degradation
- Geo. Soc. Am. Bull.
- Quaternary Research

### *Introductory and general soil and water sciences books:*

- Brady, N.C., and R.R. Weil. 2000. Elements of the nature and properties of soils. Prentice Hall, Upper Saddle River, NJ.
- Hillel, D.J. 1991. Out of the earth - Civilization and the life of the soil. The free Press, NY.
- Loynachan, T.E., K.W. Brown, T.H. Cooper, and M.H. Milford. 1999. Sustaining our soils and society. AGI Environ. Awareness Series 2. American Geological Institute, Alexandria, VA.
- Sposito, G., and R.J. Reginato (eds.). 1992. Opportunities in basic soil science research. Soil Sci. Soc. Am., Inc. Madison, WI.
- Sumner, M.E. (ed.-in-chief). 2000. Handbook of soil science. CRC Press, Boca Raton, FL.

- National Research Council (NRC). 1991. Opportunities in the hydrologic sciences. National Academy Press, Washington, D.C.
- National Research Council (NRC). 1993. Soil and water quality: An agenda for agriculture. National Academy Press, Washington, D.C.
- National Research Council (NRC). 1993. Ground water vulnerability assessment – Contamination potential under conditions of uncertainty. National Academy Press.
- National Research Council (NRC). 1999. New strategies for America's watersheds. National Academy Press, Washington, D.C.
- National Research Council (NRC). 2001. Basic research opportunities in earth science. National Academy Press, Washington, D.C.
- National Research Council (NRC). 2001. Envisioning the agenda for water resources research in the twenty-first century. National Academy Press, Washington, D.C.
- National Research Council (NRC). 2001. Grand challenges in environmental sciences. National Academy Press, Washington, D.C.
- National Research Council (NRC). 2001. Conceptual models of flow and transport in the fractured vadose zone. National Academy Press, Washington, D.C.

*Soil physics related references:*

- Childs, E.C. 1969. An introduction to the physical basis of soil water phenomena. John Wiley & Sons Ltd.
- Corwin, D.L., K. Loague, and T.R. Ellsworth (eds.). 1999. Assessment of non-point source pollution in the vadose zone. Geophysical Monograph 108. American Geophysical Union, Washington, DC.
- Baveye, P., J.-Y Parlange, and B. A. Stewart. 1999. Fractals in Soil Science. Advances in Soil Science. CRC Press, Boca Raton, FL.
- Gish, T.J., and A. Shirmohammadi (ed.). 1991. Preferential flow. Proceedings of the National Symposium. Dec. 16-17, 1991, Chicago, IL. American Society of Agri. Engineers.
- Shirmohammadi, A. (ed.). 2000. Preferential Flow - Water Movement and Chemical Transport in the Environment. ASAE, St. Joseph, Michigan.
- Hillel, D.J. 1980. Fundamentals of soil physics. Academic Press, NY.
- Hillel, D.J. 1982. Applications of soil physics. Academic Press, NY.
- Jury, W.A., W.R. Gardner, and W.H. Gardner. 2001. Soil physics. 6th ed. John Wiley & Sons, Inc.
- Marshall, T.J., and J.W. Holmes. 1996. Soil physics. 3rd ed. Cambridge Univ. Press, Cambridge.
- van Genuchten, M. Th., R., L. Feike, and L. Wu (eds.) 1999. Proceedings of International Workshop on Characterization and Measurement of the Hydraulic Properties of Unsaturated Porous Media

*Hydrology related references:*

- Kirkby, M.J. 1978. Hillslope Hydrology. Wiley.
- Anderson, M.G., and T.P. Burt. 1990. Process Studies in Hillslope Hydrology. Wiley.
- Hornberger G. et al. 1998. Elements of Physical Hydrology. Johns Hopkins Univ. Press.
- Drever, J.I. (Ed.). 2004. Surface and Ground Water, Weathering, and Soils. Elsevier.
- Bear, J. 1972. Dynamics of fluids in porous media. Elsevier, NY.
- Dullien, F.A.L. 1992. Porous media: Fluid transport and pore structure. 2nd ed. Academic Press.
- Fetter, C.W. 1993. Contaminant Hydrogeology. Macmillan, NY.
- Parlange, M.B., and J.W. Hopmans (eds.). 1999. Vadose zone hydrology – Cutting across disciplines. Oxford University Press, NY.
- Sposito, G. (ed.). 1998. Scale dependence and scale invariance in hydrology. Cambridge Univ. Press, UK.
- Tenhunen, J.D., and P. Kabat (eds.). 1999. Integrating Hydrology, Ecosystem Dynamics, and

*Pedology related references:*

- Jenny, H. 1941. Factors of Soil Formation – A System of Quantitative Pedology. McGraw-Hill, New York.
- Mausbach, M.J., and L.P. Wilding (eds.). 1991. Spatial variabilities of soils and landforms. SSSA Special Publication #28, Soil Sci. Soc. Am., Inc., Madison, WI.
- Bryant, R., and M.R. Hoosbeek (eds.). 1994. Quantitative modeling of soil forming processes. Soil Sci. Soc. Am. Special Publ. #39, Madison, WI.
- Rabenhorst, M.C., J.C. Bell, and P.A. McDaniel. 1998. Quantifying soil hydromorphology. SSSA Special Pub. #54, Soil Sci. Soc. Am., Inc, Madison, WI.
- Richardson, J.L., and M.J. Vepraskas. 2001. Wetland soils: genesis, hydrology, landscapes, and classification. LEWIS, CRC Press, Boca Raton, FL.
- Wilding, L.P., N.E. Smeck, and G.F. Hall (ed.). 1983. Pedogenesis and soil taxonomy. I. Concepts and interactions. 1st ed. Elsevier, Amsterdam, The Netherlands.

*Geomorphology related references:*

- Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. Fluvial processes in geomorphology. Freeman, San Francisco.
- Rodriguez-Iturbe, I. and A. Rinaldo, 1997. Fractal river basins, chance and self-organization. Cambridge University Press, Cambridge, Unite Kingdom.
- Huggett, R., and R. J. Huggett. 2002. Fundamentals of Geomorphology. Routledge.
- Ritter, D. F., R.C. Kochel, and J. R Miller. 2001. Process Geomorphology. 4 edition. McGraw-Hill.

*Landscape-soil-hydrology **research methodology** references:*

- Klute, A. (ed.) 1986. Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods. Monograph 9. Soil Science Society of America, Inc., Madison, WI.
- Weaver, R.W., S. Angle, P. Bottomley (ed.) 1994. Methods of Soil Analysis. Part 2. Microbiological and Biochemical Properties. SSSA Book Ser. 5. Soil Science Society of America, Inc., Madison, WI.
- Sparks, D.L. (ed.) 1996. Methods of Soil Analysis. Part 3. Chemical Methods. SSSA Book Ser. 5. Soil Science Society of America, Inc., Madison, WI.
- Dane, J.H., and G.C. Topp (ed.) 2002. Methods of Soil Analysis. Part 4. Physical Methods. SSSA Book Ser. 5. Soil Science Society of America, Inc., Madison, WI.
- Soil Survey Staff. 1993. Soil Survey Manual. U.S. Dept. Agri. Handbook No. 18. U.S. Government Printing Office, Washington, DC.
- Soil Survey Staff. 1999. Soil Taxonomy – A Basic System of Soil Classification for Making and Interpreting Soil Surveys. 2<sup>nd</sup> edition. USDA-NRCS Agricultural Handbook No. 436. U.S. Government Printing Office, Washington, DC.

