

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 4th 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)

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)

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.

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

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 1st 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/
- 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/
- 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
- Wikipedia – Free online encyclopedia: 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=
- 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. 2nd edition. USDA-NRCS Agricultural Handbook No. 436. U.S. Government Printing Office, Washington, DC.

