

The Hebrew University of Jerusalem

Syllabus

SOIL CHEMISTRY - 71972

Last update 16-04-2020

HU Credits: 4

Degree/Cycle: 2nd degree (Master)

Responsible Department: Soil and Water Sciences

Academic year: 0

Semester: 2nd Semester

Teaching Languages: Hebrew

Campus: Rehovot

Course/Module Coordinator: Prof. Moshe Shenker

Coordinator Email: Moshe.Shenker@mail.huji.ac.il

Coordinator Office Hours: Sunday 15-16

Teaching Staff:

Prof Moshe Shenker
Ms.

Course/Module description:

The course will deal with various aspects of the chemical interactions between the three phases of the soil and focus on equilibria and non-equilibria states and kinetic considerations with reference to processes that control the composition of soil solutions. We shall highlight processes that are related to plant nutrition and soil fertility, as well as issues related to pedology, the environment and soil pollution. We shall discuss dissolution-precipitation processes and stability states of multi-component systems; We shall detail the Ca-SO₄-gypsum, the CO₂-H₂O, the Ca-carbonate, the phosphate, and the metal-chelate systems. We shall construct and use stability diagrams and learn the computer use of geochemical models (using Species and GeoChem-EZ).

Course/Module aims:

Understanding the geochemical approach to examine states and processes in the soil and provide tools for the examination of these systems.

Learning outcomes - On successful completion of this module, students should be able to:

Understanding the geochemical approach to examine states and processes in the soil; Acquisition tools for the examination of these systems: stability diagrams, Species spreadsheet and Geochem-EZ software.

Attendance requirements(%):

100

Teaching arrangement and method of instruction: 2 hour lectures and 2-hour lab. The lab will be in part in the computer class

Course/Module Content:

1. The soil chemical system: - thermodynamics, the power and limitations ; treatment principles of equilibrium equations .
- 2 . Reactions in an aqueous environment ; multiple-step reactions ; transformations of minerals ;
- 3 . Activity and activity constant . Law phases .
- 4 . Gypsum soils ; treatment gypsum equilibrium in clean system. Ion pairs . Solution equilibrium with equilibrium constants and mass balance .

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5. Minerals " soft " in versus minerals "stiff " 'In soils - mineral solubility of silica , aluminum and Aluminosilicates .
 6. CO₂ - water system . A carbonate system in soils . Carbonate minerals . CO₂ - water system - calcite . Mass and decline in CO₂ - Water - calcite - equilibrium , pH and partial pressures of CO₂ .
 - 7 . Use a spreadsheet Species to solve equilibrium situations in solution. Troubleshooting application components in many systems .
 - 5 . Stability diagrams of minerals in the soil. Sub- saturation conditions and their significance in the saturated ground .
 6. Geochemical Models . Using the computer for solving equilibrium situations in solution. Study Geochem - EZ software and practice using it .
 - 7 . Phosphorus in soils . Geochemical characterization analysis of soil .
 - 8 . Iron soils . Oxidation states - Redox soils . Geochemical characterization analysis of soil .
 9. Chemistry of chelates in the soil solutions and hydroponic nutrient solution .

Required Reading:

Will be assigned during the course

Additional Reading Material:

1. Bohn, H.L., B.L. McNeal, and G.A. O'Connor. 2001. Soil Chemistry. 3rd ed. (1985, 2nd ed). John Wiley & Sons, New York. √ 631.41-BOH
2. Bolt, G.H. (ed.). 1976. Soil Chemistry. Elsevier Sci. Pub. Co., Amsterdam. 631.41-BOL
3. Dixon J.B. and Weed S.B. (Eds.) 1989. Minerals in Soil Environments. 2nd ed. SSSA. Madison WI. √ 631.411-SOI
4. Essington, M.E. 2004. Soil and Water Chemistry. CRC Press. √ 631.41-ESS
5. Evangelow, V.P. 1998. Environmental Soil and Water Chemistry. John Wiley & Sons Inc. New York. √ 628.5-EVA
6. Greenland, D.J. and M.H. Hayes. 1981. The Chemistry of Soil Processes. John Wiley & Sons, New York. √ 631.41-GRE
7. Lindsay, W.L. 1979. Chemical Equilibria in Soils. John Wiley & Sons, New York. √ 631.41-LIN
8. Mortvedt, J.J., F.R. Cox, L.M. Shuman, and R.M. Welch (Eds.). 1991. Micronutrients in Agriculture. 2nd edition. SSSA Book Series, no. 4. SSSA Inc. Madison, WI. 631.411-SOI
9. Schulthess, C.P. 2005. Soil chemistry with applied mathematics. Victoria, BC. √ 631.4-SCH
10. Sparks, D.L. (ed.). 1999. Soil Physical Chemistry. CRC Press, Boca Raton. √ 631.41-SOI
11. Sparks, D.L. 2003. Environmental Soil Chemistry. 2nd ed. Academic Press, San Diego. √ 631.41-SPA

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12. Sposito, G. 1994. *Chemical Equilibria and kinetics in soils*. Oxford University Press, New-York. ש 631.41-SPO
13. Tabatabai, M.A. and D.L. Sparks (eds.). 2005. *Chemical processes in soils*. Soil Sci. Soc. Am. ש 631.41-CHE
- כתבי עת:
14. Soil Science Society of America J. Sections of: Soil chemistry
15. European J. of Soil Science
16. Journal of Environmental Quality

Course/Module evaluation:

End of year written/oral examination 65 %

Presentation 0 %

Participation in Tutorials 0 %

Project work 0 %

Assignments 10 %

Reports 25 %

Research project 0 %

Quizzes 0 %

Other 0 %

Additional information:

Final exam will be carried as home exam IF regulation will not allow class exam.