APBI 200

Introduction to Soil Science

TERM 2 - 2015/16

Instructor 001: Maja Kržić (office – MCML227); e-mail: maja.krzic@ubc.ca
Instructor 002: Sandra Brown (office – MCML156C); e-mail: sandra.brown@ubc.ca

Lectures:
M, W, F @ 11:00 – noon
Section 001 lectures – MCML166
Section 002 lectures – Earth Sci. Build. 1012

Lab:
L01 – Monday @ 13:00-15:00
L06 – Tuesday @ 8:00-10:00
L03 – Tuesday @ 13:00 – 15:00
L07 – Wednesday @ 9:00-11:00
L09 – Wednesday @ 15:00-17:00
L04 - Monday @ 15:00-17:00
L02 – Tuesday @ 10:00-12:00
L05 – Tuesday @ 15:00-17:00
L08 – Wednesday @ 13:00-15:00
Lab location – MCML102A

Maja’s office hour: Wednesday @ 12:00 –13:00 or by appointment
Sandra’s office hour: Monday @ 9:00 –10:00 or by appointment

COURSE OVERVIEW

The objective of this course is to give you a fundamental knowledge of soil science. If you are a student interested in agricultural, forest, rangeland, wetland, or constructed ecosystems, a basic understanding of soils is essential for you. The soil provides an ideal system in which to observe practical applications for basic principals of biology, chemistry, and physics. In turn, these principles can be used to minimize the degradation of soil as one of fundamental natural resources.

Learning objectives for this course are: (i) identify and characterize elementary aspects of soil formation, (ii) discuss basic soil physical, chemical, biological, and morphological properties, (iii) explain behavior of soils in managed and natural landscapes, and (iv) identify 10 soil orders in the Canadian soil classification system.

TEXTBOOK, LECTURE NOTES, AND LABORATORY MANUAL


2) SoilWeb200. 2014. On-line teaching tool for the APBI (formerly SOIL) 200 course, developed by Dr. Krzic’s team available at http://soilweb200.landfood.ubc.ca/

3) Lecture notes are available at the UBC Wiki site for this course (http://wiki.ubc.ca/Course:APBI200).

4) Lab manual is available at the UBC Wiki site for this course (http://wiki.ubc.ca/Course:APBI200).

REFERENCES
River, NJ. 881 pp. [On reserve in the Woodward library]

### SCHEDULE OF LABS, EXAMS, AND PROBLEM SETS

<table>
<thead>
<tr>
<th>Date</th>
<th>Week no.</th>
<th>Lab</th>
<th>Problem sets / Midterm exam</th>
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<td>JAN</td>
<td>4-8</td>
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<td></td>
<td>11-15</td>
<td>2 Lab 1 - Campus field trip (weather permitting)</td>
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<td>18-22</td>
<td>3 Lab 2 – Soil texture &amp; bulk density</td>
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<td>18</td>
<td>3</td>
<td>Problem set #1 due</td>
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<td>25-29</td>
<td>4 Lab 3 – Water retention</td>
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<td>FEB</td>
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<td>8-12</td>
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<td>6 Family Day – UBC closed</td>
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<td>12</td>
<td>6</td>
<td>Problem set #2 due</td>
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<td>15-19</td>
<td>7 Spring break – UBC closed</td>
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<td>22 – 26</td>
<td>8 Lab 4 - Soil chemistry</td>
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<td>Feb 26 (Friday)</td>
<td>8</td>
<td>Midterm exam</td>
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<td>MAR</td>
<td>Feb 29-Mar 4</td>
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<td>Lab 5 – Parent material</td>
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<td>7-11</td>
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<td>14-18</td>
<td>11 Lab 6 – Forest floor -NEW</td>
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<td>21- 25</td>
<td>12 Lab 7 – Soil classification</td>
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<td>23</td>
<td>12</td>
<td>Problem set #3 due</td>
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<td>Mar 25</td>
<td>12 Good Friday – UBC closed</td>
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<td>Mar 28</td>
<td>13 Easter Monday – UBC closed</td>
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<td>Mar 28-Apr 1</td>
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<td>4-8</td>
<td>14 Lab 8 – Soil description (field trip)</td>
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<td>8</td>
<td>14 Last day of classes</td>
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GRADING

1. Mid-Term Exam (Feb 26, 2016)  25%
2. Laboratory Assignments  20%
3. Problem Sets  10%
4. Final Exam  45%

Note for auditors - For Auditor status to be entered on the transcript you will have to attend at least 75% of the lectures and to submit problem sets and laboratory assignments.

Note about plagiarism - As a university student, you are expected to submit original work and give credit to other peoples' ideas; hence, plagiarism will not be tolerated. If you are unclear on the concept, please see http://learningcommons.ubc.ca/resource-guides/avoiding-plagiarism/

Academic Honesty – Academic honesty is a core value of scholarship. Cheating and plagiarism (including both presenting the work of others as your own and self-plagiarism) are serious academic offences that are taken very seriously at UBC. By registering for courses at UBC, students have initiated a contract with the University that they will abide by the rules of the institution. It is the student’s responsibility to inform themselves of the University regulations. Definitions of Academic Misconduct can be found on the following website http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959

If you are unsure of whether you are properly citing references, please ask your instructors for clarification before the assignment is submitted.

LECTURE TOPIC OUTLINE

1. Introduction (Reading: Brady&Weil Ch.1*)
   - Course objectives and organization
   - “Soil” definitions and viewpoints
   - Factors of soil formation; pedon; polypedon; soil horizons; solum; soil profile

2. Soil physics (Reading: Brady&Weil Ch.4, 5, 7)
   - Soil phases; constituents; mass and volume relationships
   - Soil separates and texture classes, Stockes’ Law
   - Particle mineralogy and its effects on physical properties (e.g. quartz, kaolinite, montmorillonite); origin and magnitude of permanent and pH-dependent charge (Brady&Weil Ch.8.1 to 8.6)
   - Inter-particle forces; flocculation and dispersion
   - Soil consistency; plastic and liquid limits; soil strength, puddling
   - Soil structure: formation, stabilization, classification and significance
   - Soil water: energy status, retention and flow. Potential components; matric potential and soil water tension; water retention characteristics and air entry value; water potential gradient; Darcy’s Law and hydraulic conductivity; “field capacity”; “permanent wilting point’, and “available water storage capacity” concepts and limitations
   - Soil thermal behavior: Fourier’s Law; soil thermal conductivity and heat capacity
   - Diffusion in porous media: Fick’s Law; diffusion coefficient
   - Soil aeration: convective and diffusive exchange; composition of soil air
   - Solute transport in soil: mass flow and diffusion; transport to roots; leaching; migration of ions in an electric field, diffuse double layer
3. Soil chemistry (Reading: Brady&Weil Ch. 8, 9)
   - Reversible reactions; mass action; equilibrium constant, ionization, dissociation constant: a brief review
   - Soil pH and acidity; soil pH buffers and buffering
   - Ion adsorption and exchange; ion exchange capacities; crystalline & amorphous clay colloids
   - “Base” cations; exchangeable aluminum; hydroxyaluminum behavior and significance

4. Soil organic matter (Reading: Brady&Weil Ch. 11)
   - Introduction: definition of some terms
   - Some physical properties of organic layers
   - Components of soil organic matter; humic substances and their principal functional groups; chelates and siderophores
   - Some chemical properties of soil organic matter; CEC; C and N conc., nutrient ratios; significance of C/N ratio
   - Organic horizons in soils
   - Forest humus forms: morphology, development, classification, and significance

5. Soil biology and biochemistry (Reading: Brady&Weil Ch. 10, 12, 13)
   - Major groups of soil organisms and their roles
   - Microbial physiology in the soil environment: physico-chemical environment, nutrition, energy and metabolism, growth and reproduction
   - Biochemical transformations of N, S, and P in soils
   - Interactions of soil microbes with plant roots: rizosphere; N-fixing root nodule symbioses; mycorrhizae

6. Soil as a source of plant nutrients (soil fertility) (Reading: Brady&Weil Ch. 13)
   - Nutrient transport to roots and nutrient uptake by roots
   - Nutrient elements and forms; non-nutrient elements taken up by roots
   - Processes affecting amount, forms and availability (to plants) of nutrients and toxic elements in soil
   - Regulation of soil pH

7. Weathering and soil formation; Soil classification and survey (Reading: Brady&Weil Ch. 2 and Lab manual, labs no. 5 and 6)
   - Parent material characteristics
   - Influence of the “factors of soil formation”; physical and chemical weathering, soil-forming processes
   - Classification concepts; technical and natural classifications; Canadian System of Soil Classification hierarchy; horizons and horizon symbols; soil orders and great groups; subgroup designation; soil families and soil series
   - Soil survey and mapping: scales, methods and sampling intensities; map units; soil maps vs. interpretative maps; soil capability classification and mapping

8. Soil science in environmental management and problem-solving (Reading: Brady&Weil Ch. 14, 15)
   - Soil erosion: overview of processes, prevention and control
   - Soils and waste management: nutrient cycling
   - Soils and land use conflicts at the urban-rural interference
   - Soils and forest management

*Associated reading in the textbook by Brady and Weil 2010.*