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

L04 - Monday @ 15:00-17:00

L06 – Tuesday @ 8:00-10:00

L02 – Tuesday @ 10:00-12:00

L03 – Tuesday @ 13:00 – 15:00

L05 – Tuesday @ 15:00-17:00

L07 – Wednesday @ 9:00-11:00

L08 – Wednesday @ 13:00-15:00

L09 – Wednesday @ 15:00-17:00

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

1) **Brady N.C., and R.R. Weil. 2010.** Elements of the nature and properties of soils (3rd ed.). Pearson Education (Prentice Hall), Upper Saddle River, NJ. 624 pp.
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

Brady N.C., and R.R. Weil. 2002. The nature and properties of soils. 13th ed. Prentice Hall, Upper Saddle

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

Gardiner, D.T. and Miller, R.W. 2004. Soils in our environment. 10th ed. Prentice Hall, NJ. 641 pp.

Rowell, D.L. 1994. Soil science: methods and applications. Longman Scientifci & Technical. UK. 350 pp.

Singer, M.J. and Munns, D.N. 2002. Soils: an introduction. 5th ed. Prentice Hall, Upper Saddle River, NJ. 429 pp.

Soil Science Society of America. 1997. Glossary of soil science terms. SSSA, Madison, WI. 138 pp. Available online at: https://www.soils.org/publications/soils-glossary

White, R.E. 1997. Principles and practice of soil science: the soil as a natural resource. 3rd ed. Blackwell Science Ltd., Oxford, UK. 348 pp.

SCHEDULE OF LABS, EXAMS, AND PROBLEM SETS

Date		**Week no.**	**Lab**	**Problem sets / Midterm exam**
JAN	4-8	1		
	11-15	2	Lab 1 - Campus field trip (weather permitting)	
	18-22	3	Lab 2 – Soil texture & bulk density	
	18	3		Problem set #1 due
	25-29	4	Lab 3 – Water retention	
FEB	1-5	5		
	8-12	6		
	8	6	Family Day – UBC closed	
	12	6		Problem set #2 due
	15-19	7	Spring break – UBC closed	
	22 – 26	8	Lab 4 - Soil chemistry	
	Feb 26 (Friday)	8		Midterm exam
MAR	Feb 29-Mar 4	9	Lab 5 – Parent material	
	7-11	10		
	14-18	11	Lab 6 – Forest floor -NEW	
	21- 25	12	Lab 7 – Soil classification	
	23	12		Problem set #3 due
	Mar 25	12	Good Friday – UBC closed	
	Mar 28	13	Easter Monday – UBC closed	
APR	Mar 28-Apr 1	13		
	4-8	14	Lab 8 – Soil description (field trip)	
	8	14	Last day of classes	

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 instructos 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.