APBI 200

Introduction to Soil Science

TERM 2 - 2018/19

Instructor 001: Sandra Brown (office – MCML229); e-mail: sandra.brown@ubc.ca

Lectures: M, W, F @ 11:00 – noon

Section 001 lectures – Forest Sciences Centre 1005

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

Sandra's office hour: Wednesday @ 10:00 –11:00 (in McMl 229)

TA office hours: (in room 102A)

Monday 10:00-1100; 12:00-1:00	Tuesday 12:00-1:00
Wednesday 12:00-1:00	Thursday 12:00-1:00
Friday 12:00-1:00	

COURSE OVERVIEW

The **objective** of this course is to give you a fundamental knowledge of soil science. If you are a student interested in forest, agricultural, urban, rangeland, and 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 resource for the APBI200 course (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. 2016, 2008, 2002. The nature and properties of soils. 13th ed. Prentice Hall, Upper Saddle River, NJ. 881 pp. [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 / Exams**
JAN	2-4	1		
	7-11	2	Lab 1 - Campus field trip (weather permitting)	
	14-18	3	Lab 2 – Soil texture & bulk density	
	18	3		Problem set #1 due
	21-25	4	Lab 3 – Water retention	
FEB	Jan 26-Feb 1	5	Lab 4 – Parent material	
	4	6		Feb 4 – Midterm Exam #1
	4-8	6		
	11-15	7		
	15	7		Problem set #2 due
	18-22	8	Reading break – no classes	
	25 – Mar 1	9	Lab 5 - Soil chemistry	
MAR	Mar 4-8	10		
	11	11		Mar 11 – Midterm Exam #2
	11-15	11	Lab 6 – Forest floor	
	18-22	12	Lab 7 – Soil classification	
	25-29	13	Lab 8 – Soil description (field trip)	
APR	1-4	14		
	3	14	Our last class	Problem set #3 due

GRADING

1.	Mid-Term Exams (*Feb 4 & Mar 11, 2018*)	25%
2.	Laboratory Assignments*	20%
3.	Problem Sets	10%
4.	Final Exam	45%

***** *Up to 3 bonus assignments can be submitted by each student for up to 6% bonus towards the lab assignments mark (for more info see http://wiki.ubc.ca/Course:APBI200/Bonus_Assignments)*

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/avoid-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 TOPICS

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
- 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: a brief review
- Soil pH and acidity; soil buffering capacity
- Ion adsorption and exchange; ion exchange capacities; crystalline & amorphous clay colloids
- Base-forming cations; exchangeable aluminum; hydroxyaluminum behavior and significance

4. Soil organic matter (Reading: Brady&Weil Ch.11)

- Soil organic matter: definition and roles it plays in soil
- Some physical properties of organic layers
- Components of soil organic matter; humic substances and their functional groups; chelates
- Some chemical properties of soil organic matter; CEC; C and N conc.; significance of C/N ratio
- Soil organic horizons

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

7. Weathering and soil formation; Soil classification (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; horizons and horizon symbols; soil orders and great groups; subgroup designation; soil families and soil series
- Forest humus forms: morphology, development, classification, and significance

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

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