APBI 200

Introduction to Soil Science

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.

TERM 2 - 2019/20

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Lectures: Monday, Wednesday, Friday:

@10-11 (Section 001)

@11 – noon (Section 002)

Lectures for both sections 001 & 002 are in MCML166

Lab sections:

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 @ 8:00-10:00	L08 – Wednesday @ 13:00-15:00
L09 – Wednesday @ 15:00-17:00	L10 – Thursday @ 10:00-12:00

All lab sections are in MCML102A

Instructors' office hour: Wednesday @ 12:00 –13:00

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 outcomes for this course are: (i) identify and characterize elementary aspects of soil formation, (ii) describe basic soil physical, chemical, biological, and morphological properties, (iii) characterize 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).

LECTURES, LABS, EXAMS, AND PROBLEM SETS

Lecture #	Date	*COURSE UNIT* & Lecture topics	Labs & Problem sets
1	Jan 6 (M)	Course introduction	
2	Jan 8 (W)	*SOIL COMPONENTS* *Soil in perspective*: A. What is soil?; B. Some special terms used in soil science - pedon; polypedon; soil horizons; solum; soil profile; C. Soil components	
3	Jan 10 (F)	*SOIL CLASSIFICATION* *Weathering and soil formation:* A. Weathering processes (physical, chemical and biological); B. Five factors of soil formation	
4	Jan 13 (M)	*SOIL COMPONENTS* *Soil physics - solids 1. Background and terminology*: A. Soil as a 3-phase system; B. Mass and volume relationships; C. Soil particles and texture	Jan 13-17: Lab 1 - Campus field trip (weather permitting)
5	Jan 15 (W)	*SOIL COMPONENTS* *Soil physics - solids 2. Particle mineralogy and its effects on physical properties*: A. Some properties of soil particles; B. Phyllosilicate clay minerals	
6	Jan 17 (F)	*SOIL COMPONENTS* *Soil physics - solids 3. Particle mineralogy and its effects on physical properties*: A. Phyllosilicate clay minerals – cont. B. Inter-particle forces, flocculation and dispersion	

7	Jan 20 (M)	*SOIL COMPONENTS* *Soil physics - solids 4. Soil consistency and structure:* A. Soil structure: formation, stabilization, classification and significance; B. Soil consistency; plastic and liquid limits; soil strength, puddling	Jan 20-24: Lab 2 – Parent material
8	Jan 22 (W)	*SOIL COMPONENTS* *Soil organic matter (SOM):* A. Introduction of basic SOM-related terms; B. Components of SOM; C. Properties of SOM	
9	Jan 24 (F)	*SOIL COMPONENTS* *Soil physics - water 1. Soil water*: A. Energy concepts; B. Water potential	Problem set #1 due
10	Jan 27 (M)	*SOIL COMPONENTS* *Soil physics - water 2. Soil water:* A. Soil matric potential and its relationship to soil water content; B. Water retention characteristics and air entry value	Jan 27-31: Lab 3 – Soil texture & bulk density
11	Jan 29 (W)	*SOIL COMPONENTS* *Soil physics - water 3. Soil water flow:* A. Inferring the direction of water flow; B. Water potential gradient, C. Soil hydraulic conductivity	
12	Jan 31 (F)	*SOIL COMPONENTS* *Soil physics - water 4. Qualitative description of soil wetness:* A. Max. retentive capacity; B. Field capacity, C. Permanent wilting point, D. Available water storage capacity, E. Hygroscopic coefficient	
13	Feb 3 (M)	*SOIL COMPONENTS* *Soil physics. Soil thermal behavior and properties*: A. Thermal behavior (Fourier's Law); B. Soil thermal properties (conductivity, capacity, admittance, diffusivity)	Jan 29-Feb 2: Lab 4 – Water retention
14	Feb 5 (W)	**PRACTICE EXAM SESSION NO.1** *Rms:MCML 258 & 342 – booked for both sections*	
15	Feb 7 (F)	Midterm #1	

16	Feb 10 (M)	*SOIL COMPONENTS* *Soil physics. Soil aeration*: A. Nature of soil aeration; B. Diffusion (Fick's Law); C. Solute transport processes (mass flow and diffusion, diffuse double layer)	
17	Feb 12 (W)	*SOIL COMPONENTS* *Soil chemistry - part 1. Soil reaction.* A. Soil pH and acidity, B. Soil salinity; C. Introduction to ion adsorption and exchange reactions	
18	Feb 14 (F)	*SOIL COMPONENTS* *Soil chemistry - part 2. Ion adsorption & exchange:* A. Cation exchangeable capacity; B. Base saturation; C. Exchangeable cations; D. Anion exchange capacity	Problem set #2 due
	Feb 17 (M)	*Family Day – UBC closed*	
	Feb 19 (W)	*Spring break*	
	Feb 21 (F)	*Spring break*	
19	Feb 24 (M)	*SOIL COMPONENTS* *Soil chemistry - part 3. Soil organic matter - cont:* A. Mineralization and immobilization; B. C/N ratio; C. pH dependent charge; D. Chelates; E. Significance of SOM	Feb 24 – 28: Lab 5 - Soil chemistry
20	Feb 26 (W)	*SOIL CLASSIFICATION* A. Organic soils; B. Organic horizons in soils	
21	Feb 28 (F)	*SOIL BIOLOGY & NUTRIENTS* *Soil biology - part 1.* Major groups of soil organisms and their roles	
22	Mar 2 (M)	*SOIL BIOLOGY & NUTRIENTS* *Soil biology - part 2.* A. Abundance of soil organisms; B. Soil food web	Mar 2-6: Lab 6 – Forest floor

23	Mar 4 (W)	*SOIL BIOLOGY & NUTRIENTS* *Soil biology - part 3. Biochemical transformations and interactions of soil microbes with plant roots:* A. Biological N fixation, mineralization/immobilization, denitrification; B. Interactions of soil microbes with plant roots (rhizosphere and mycorrhizae)	
24	Mar 6 (F)	*SOIL BIOLOGY & NUTRIENTS* *Soil fertility - part 1. Nutrients and availability:* A. Plant nutrients. B. Retention and release of nutrients; C. Transport to roots and nutrient uptake by roots; D. Nutrient cycles: N, S	
25	Mar 9 (M)	*SOIL BIOLOGY & NUTRIENTS* *Soil fertility - part 2. Nutrients and availability:* A. Nutrient cycles: P. B. Nutrient cycles: K	
26	Mar 11 (W)	*SOIL BIOLOGY & NUTRIENTS* *Soil fertility - part 3. Nutrients and availability:* A. Nutrient cycles: Ca and Mg	
27	Mar 13 (F)	**PRACTICE EXAM SESSION NO.2** *Rms:MCML 342, MCML102A - booked for both sections*	
28	Mar 16 (M)	Midterm #2	
29	Mar 18 (W)	*SOIL CLASSIFICATION* *Pedology - part 1. Classification concepts:* A. Soil forming processes; B. Soil classification; C. Soil horizons	
30	Mar 20 (F)	*SOIL CLASSIFICATION* *Pedology - part 2. Canadian System of Soil Classification:* A. The Canadian system of soil classification; B. Soil orders (Regosol, Brunisol, Chernozem, Solonetz, Luvisol, Gleysol)	

31	Mar 23 (M)	*SOIL CLASSIFICATION* *Pedology - part 3. Canadian System of Soil Classification:* A. Soil orders (Podzol, Organic, Cryosol, Vertisol), B. Soil classification and genesis	Lab 7 – Soil classification
32	Mar 25 (W)	*SOIL MANAGEMENT* *Urban Soils*	
33	Mar 27 (F)	*SOIL MANAGEMENT* **Career day with 4th yr undergrad students**	Problem set #3 due
34	Mar 30 (M)	*SOIL MANAGEMENT* *Soil degradation:*: overview of processes, prevention and control	Mar 30 –Apr 3: Lab 8 – Soil description, field trip
35	Apr 1 (W)	**PRACTICE EXAM SESSION NO.3** *Rms:MCML 258 & 342 – booked for both sections*	
36	Apr 3 (F)	*SOIL MANAGEMENT* Soil ecosystem services (i.e. summary of why are soils important)	
37	Apr 6 (M)	Course units interactions	
38	Apr 8 (W)	Course summary & game	

GRADING

1. Mid-Term Exams (*Feb 7 & Mar 16, 2020*) 25%
2. Laboratory Assignments* 25%
3. Problem Sets 10%
4. Final Exam 40%

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

All reports should be handed in ontime and **a 10% mark subtraction will be made for each day being late. Assignments submitted passed day 4 will not be accepted**.

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 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 at 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.

GRAPHYC SYLLABUS, showing 4 course units & associated lecture topics

SOIL COMPONENTS

- **Soil solids**
  - Mineral particles (sand, silt, clay), their size & composition
  - Soil organic matter
- **Soil water**
- **Soil air**
- ***Important properties of soil componets***
  - Soil texture
  - Bluk density & particle density
  - Porosity, pore size distribution, and aggregation (i.e. soil structure)
  - Presence of charge on soil particles & ion adsorption
  - Water retention
  - Therimal properties
  - Soil reaction
  - Salinity

SOIL BIOLOGY & NUTRIENTS

- **Soil organisms**
  - Major groups of soil organisms
  - Biochemical transformations carried out by organisms:
    - Biological N fixation
    - Mineralization & immobilization
    - Denitrification
  - Interactions of soil microbes with plant roots (rhizosphere and mycorrhizae)
- **Nutrient cycles**
  - N cycle
  - S cycle
  - P cycle
  - K cycle
  - Ca and Mg

SOIL CLASSIFICATION

- **Soil formation & weathering**
  - Five factors of soil formation
  - Soil formation processes (additions, translocations, transformationa, losses)
- **Soil horizons & forest floor**
- **Canadian system of soil classification & 10 soil orders:**
  - Regosol
  - Brunisol
  - Luvisol
  - Gleysol
  - Organic soil
  - Chernozem
  - Solonetz
  - Podzol
  - Cryosol
  - Vertisol

SOIL MANAGEMENT

- Urban soils
- Soil degradation
  - Soil erosion and its control
- Soil quality
- Soil ecosystem services