

**"FUNDAMENTALS OF SITE REMEDIATION"
(EESD15H3-F L30)**

Instructor: Dr. Silvija Stefanovic

Lecture: Friday 12–3pm; MW110

Office: EV366

Office hours: Friday 10:30-12:00pm

Email: silvija.stefanovic@utoronto.ca

Phone: 416-208-4873

TAs: Bhargav Patel

Office: EV302

Office hours: TBA

Email: br.patel@alum.utoronto.ca

Intent of the course:

This course consists of a study of the ways in which hazardous organic and inorganic materials can be removed or attenuated in natural systems. The theory behind various technologies, with an emphasis on bioremediation techniques and their success in practice. An introduction to the unique challenges associated with the remediation of surface and ground water environments, soils, marine systems, and contaminated sediments.

Prerequisite: Students must have successfully completed BIOA01H3 & BIOA02H3 & CHMA10H3 & CHMA11H3 & [PHYA10H3 or PHYA11H3]

Suggested readings:

“Fundamentals of Site Remediation”, John Pichtel, 2007, The Scarecrow Press, Inc.

“Remediation technologies for soil and groundwater” [electronic resources], sponsored by Remediation Technologies for Soils and Groundwater Task Committee of the Environmental Council, Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers ; edited by Alok Bhandari ... [et al.]. Reston, Va. : American Society of Civil Engineers, c2007.

“Elements of the Nature and Properties of Soils” by N.C. Brady

Lecture notes:

The lecture slides will be posted in *.pdf format on Quercus. You will require Adobe Reader to open the files (available free of charge at www.adobe.com).

Course email policy:

Email is not an effective way of teaching and email inquiries regarding course materials will not be answered. Dr. Stefanovic will be available during designated office hours to answer questions regarding course material. If you have questions, then please see instructor during office hours – this time is for you so please do not hesitate to use it. Course TA will also be available during his designated office hours and he will respond on the emails pertaining assignments.

Grading:	Assignments (2):	20% (2x10%)
	Seminar:	10%
	Midterm	15%
	Project Presentation:	10%
	Project Report:	10%
	Participation:	5%
	Final Exam:	30%

Assignments:

You will have problems to solve for each of two group assignments (maximum two students in the group). You will be able to access the problem sheets on the Quercus at the times detailed below. More details on the assignments will be circulated during the term.

<i>Topic</i>	<i>on Quercus</i>	<i>Due date</i>
Assignment #1	Oct.4 th	Oct. 25 th
Assignment #2	Nov.8 th	Nov. 22 nd

Seminar:

You will be assigned a specific type of contaminants and you will need to present its chemistry, sources, fate, and toxicology during short in class presentation (15min). This is a group seminar with 2-3 students per group. Topics will be given during the first lecture. One page Summary plus references and Power Point slides to be sent to instructor before the presentation. Failing to submit the summary and slides will result in mark deduction of 5% per day. After the presentations the rest of the students will need to submit hand written summaries for the participation mark. More information will be circulated in the class.

Midterm:

The 1 hour multiple choice questions midterm examination is worth 15% of the final grade for the course. The midterm exam will draw from a lecture notes and *any* material priority presented in the classroom. Information from the readings and other resources not directly covered in class will not be tested on exams. More details about the exams will follow.

Final Project Presentation/Report

You will be assigned a real remediated site to critically review its problem circumstances such as site history, types and sources of contaminants, contaminant migration pathways, human and ecological receptors, natural and demographic site conditions and completed remediation techniques. This is a group project with 2-3 students per group (not necessarily the same students as for Seminar). **Topics will be assigned during the first lecture.** At the end of the term you will present your findings during 20min long in class presentation. The rest of the class will need to submit hand written summaries for the participation mark.

The hard copy of the final project report is due at the last lecture by 3pm. The length is limited to maximum 8 pages.

Final Exam:

The 2.5 hour final examination is worth 30% of the final grade for the course. It will be a combination of fill-in-the-blanks, written (short answer) questions and calculations/problem solving questions. The final exam will draw from lecture notes and *any* material presented in the classroom. Information from the readings and other resources not directly covered in class will not be tested on exams. More details about the exams will follow.

Other Course policies:

Late assignments will not be accepted and assigned a grade of zero. *Extensions will be granted ONLY with medical note or under exceptional circumstances. Your TA must be informed about that immediately.*

Plagiarism will not be tolerated. Each student/group is expected to submit **individual work** for grading. It is an academic offense to plagiarize and those who do, will be subjected to University procedures (see the University calendar).

Lecture topics:

1. Introduction, ground rules, expectations and course structure.
What is contaminated site? Introduction to soil and groundwater remediation. Sept. 6th
2. Basic soil and groundwater properties (review) Sept. 13th
3. Properties of Contaminants (**Students' seminars**) Sept. 20th
4. Properties of Contaminants (**Students' seminars**) Sept. 27th
5. Environmental site assessment; Investigative methods; Natural attenuation. **Assignment #1** Oct. 4th
READING WEEK **Oct.11th**
6. Selection of remediation procedure; Classification of techniques: Ex situ and In situ technologies;
Physical methods of trapping pollutant: Encapsulation, Stabilization, Hydraulic trap Oct.18th
7. *Physical methods involving removal of pollutants:* Excavation, Pumping water, Pumping-skimming,
Washing and entrainment by a liquid. In situ venting, Soil vapour extraction (SVE), Air stripping Oct. 25th
8. **In class midterm;** Surface water and marine systems remediation: Oil spills remediation methods;
Remediation of the soils with excessive pH; Nov. 1st
9. *Chemical Methods:* On site Washing, Oxidation, Reduction; Dechlorination,
Electrochemical techniques;
Thermal methods: Incineration, Thermal desorption, Pyrolysis, Vitrification. **Assignment #2** Nov. 8th
10. *Biological method:* Biodegradation in pile, Composting, Land farming, Bioventing and biosparging
Biobarriers and biological screens. Phytoremediation; Lagooning. Nov. 15th
11. Final Project Presentations Nov. 22nd
12. Final Project Presentations; Final Course Review. Nov.29th

I will follow this schedule as closely as possible, but things being what they are, some of these topics may "overflow" over into other time slots.