

## F'24 ESM 214/L: Biological Waste Treatment

Lecture BH1424 (Seminar Rm) T/R 12:30 – 1:45 pm; Lab R BH2015 (\*\*) 2 ~ 4:50 pm

*\*\*NOTE: Three ESM214L meetings are field trips; one meeting is on Friday (BH3035)*

**Instructor:** Trish Holden ([holden@bren.ucsb.edu](mailto:holden@bren.ucsb.edu)) Office: 3508 Bren Hall Tel: 893-3195

**Office Hours:** T 3:30 – 5 pm (except: 10/25) or by appt.

**TA:** Liviu Iancu ([liancu@bren.ucsb.edu](mailto:liancu@bren.ucsb.edu)) Office: 2027 Bren Hall

NOTE: Syllabus may change.

<b>Wk</b>	<b>Day</b>	<b>Topic</b>
1	Sept 26	Introduction, Course Background.
	<i>lab</i>	<i>Overview and safety (Room 2015 BH)</i>
2	Oct 1	Sanitation; Wastewater and Characteristics
	Oct 3	Wastewater: Collection; Surveillance
	<i>lab</i>	<i>FIELD TRIP 1: El Estero WWTP, Santa Barbara</i>
3	Oct 8	Overview Wastewater (WW) Treatment
	Oct 10	WW Treatment: Preliminary & Primary Treatment
	<i>lab</i>	<i>Exercise 1 (Room 2015 BH): Microscopy of activated sludge microbes</i>
4	Oct 15	Biological Wastewater Treatment
	<b>Oct 18</b>	2° Treatment (Activated Sludge; Fixed Film; MBRs)
	<i>lab</i>	<i>Exercise 2 (GIS lab; Room 3035 BH): Systems Simulation</i>
5	Oct 22	Biological Nutrient Removal (BNR)
	<b>Oct 25</b>	Disinfection
	<i>lab</i>	<i>Exercise 3: Watch two of the Wastewater Process Emissions Webcast Series (7/18, 9/5 or 10/31) and report back (individual).</i> <a href="https://event.webcasts.com/viewer/portal.jsp?ei=1678637&amp;tp_key=4c5a4c67d8">https://event.webcasts.com/viewer/portal.jsp?ei=1678637&amp;tp_key=4c5a4c67d8</a> <b>Exercise 1 due</b>
6	Oct 29	Tertiary Treatment and Reuse
	Oct 31	Natural Treatment Systems
	<i>lab</i>	<i>FIELD TRIP 2: Campus Biofilters</i> <b>Exercise 2 due</b>
7	Nov 5	Biosolids Management: Physical, Biological, Energy, Final Disposal
	Nov 7	Solid Waste Management: Landfills
	<i>lab</i>	<i>FIELD TRIP 3: Tajiguas Landfill</i> <b>Exercise 3 due</b>
8	Nov 12	Introduction to Haz waste; Biodegradation and biotransformation
	Nov 14	In situ Natural Attenuation
	<i>lab</i>	<i>Exercise 4: Assessing Biostimulation of Hexadecane Mineralization</i>
9	Nov 19	Biostimulation and Bioaugmentation
	Nov 21	Current Challenges: PFAS, Plastics including Textiles
	<i>lab</i>	<i>Exercise 5: Assessing Synthetic Textile Biodegradation in Soil</i>
10	Nov 26	Ex Situ treatment; Bioremediation: metals
		<i>Thanksgiving Holiday (November 24<sup>th</sup>)</i>

11	Dec 3	Course Review <b>Exercise 4 due</b>
	Dec 5	Final Presentations (1424 BH) <i>Presentations (due on Canvas, and presented) 12:30 – 4:30</i> <b>Exercise 5 due</b>

FINAL PAPERS DUE (Canvas) DECEMBER 12<sup>th</sup> (Thursday) COB.

**Course Description:** Concepts and approaches to prevent, correct, and alleviate the effects of environmental pollution using biological processes. Biochemical, ecological, and physiochemical aspects of remediation and mitigation. Assessing and monitoring applicability/efficacy of biological treatment. Natural and designed / managed methods for adversely affected biological resources.

**Student Learning Outcomes and Assessments:**

- Acquire and anchor foundational understanding of biological waste treatment.  
*In class discussion, field trips, final presentation and paper*
- Use understanding in relationship to environmental problems including pollution prevention and remediation.  
*Invocation of core concepts into exercises, field trips, final paper, and presentation*
- Discover how to find information and resources, for this course and the future.  
*Selection of topic for paper and presentation*  
*Sourcing for lab reports*
- Communicate the material; write, and present, using your knowledge gained in this course  
*Quality of written and oral assignment, based on rubric*

**Course parameters:** Prepare before class meetings: read materials on Canvas and consult other reference materials, as needed. Class time used for lecture and discussion. Field trips and Lab Exercises to enhance working knowledge of biological treatment and issues; activities are designed to augment the course.

**Requirements and grading:** Class participation (10%), Exercises (5 reports, at 10% each), final paper and presentation (20 and 10%, respectively). Field trip attendance (10%).

**Resources:** Canvas materials, Instructor / TA, UCSB Library; Web of Science

**Books (in Bren reading room or UCSB library)** useful to the course material include: Brock Biology of Microorganisms (any recent edition): a comprehensive advanced text in general microbiology. It is in its 15<sup>th</sup> edition.

<https://www.pearson.com/us/higher-education/product/Madigan-Brock-Biology-of-Microorganisms-15th-Edition/9780134261928.html>

**\*\*Wastewater Engineering: Treatment and Resource Recovery, by Metcalf & Eddy:** It is in its 5<sup>th</sup> edition.

[http://highered.mheducation.com/sites/0073401188/information\\_center\\_view0/index.html](http://highered.mheducation.com/sites/0073401188/information_center_view0/index.html)

Biodegradation and Bioremediation, by Alexander. 2<sup>nd</sup> Edition. 1999.

<https://www.elsevier.com/books/biodegradation-and-bioremediation/alexander/978-0-12-049861-1>

Bioremediation and Natural Attenuation: Process Fundamentals and Mathematical Models, by Alvarez and Illman. 2005. This is available online, and chapters can be made available during the course.

<http://onlinelibrary.wiley.com/book/10.1002/047173862X>

Standard Methods for the Examination of Water and Wastewater. It is in its 24<sup>th</sup> edition. This is the standard for how to characterize wastewater, and water.

<https://www.standardmethods.org/>

**Course policies:** Attending class is encouraged because the course is cumulative, i.e. the material builds and concepts are transferred from the first part of the course to the later parts. Preparing for class will maximize the value of the lectures. Engaging in class is graded, and encouraged for your learning; plus, your questions may assist others. Field trips are arranged for your learning, and you are required to attend all of them. The 5 written Exercise reports are individual: it will be graded accordingly. The final paper and presentation are your works, individually, and will be graded accordingly. [Academic integrity](#) is expected. Written communication is an important professional skill in ESM, and the final paper is meant to assist in developing that including how to authoritatively resource materials. Similarly, oral communication practice is gained with your final presentation. Note regarding the use of AI: while AI (e.g. Chat GPT 4.0) can be a useful tool to skim into subject material, the sources that contribute are incomplete and the integrated retrieval and synthesis of material requires careful scrutiny for professional use. [Here](#) is a useful recent article on this subject led by Professor Ruth Oliver, Bren School.

#### **Websites:**

- World Health Organization (WHO) Sanitation: <https://www.who.int/news-room/fact-sheets/detail/sanitation>
- World Health Organization (WHO) Water Sanitation and Hygiene (WASH): [https://www.who.int/health-topics/water-sanitation-and-hygiene-wash#tab=tab\\_1](https://www.who.int/health-topics/water-sanitation-and-hygiene-wash#tab=tab_1)
- USEPA Clean Water Act and NPDES permitting: <https://www.epa.gov/laws-regulations/summary-clean-water-act>
- SimpleTreat software (used in ESM214L): <https://www.rivm.nl/en/soil-and-water/simpletreat>
- USEPA Superfund: <https://www.epa.gov/superfund>
- Eawag Biocatalysis/ Biodegradation Database: <http://eawag-bbd.ethz.ch/>