

Introduction to Hazardous Waste Management

CHEE/CE 478/578 (3 units)

Spring Semester 20xx



Description: This course covers management, planning, legal and engineering aspects of liquid and solid hazardous waste treatment and disposal.

Lecture: Days / Time / Location TBD

Instructor: Dr. Reyes Sierra; Harshbarger 130. Office hours: by appointment: rsierra@email.arizona.edu

TA / Office hours: TA TBD (email, days, times TBD)

Text book: **Required:** Hazardous Wastes: Sources, Pathways, Receptors. R.J. Watts
John Wiley & Sons, Inc.; New York; January 1998, ISBN: 0-471-00238-0

Reference book (not required): Hazardous Waste Management.
LaGrega et al. (2nd Edition). 2001; McGraw-Hill, ISBN. 978-1577666936

Readers will be used to supplement some classes. Readers will be posted in the course web site several hours before the class.

Course objectives and outcomes

- 1) Students will be able to define and characterize solid and hazardous wastes from technical and regulatory points of view.
- 2) Students will identify key sources, typical quantities generated, composition, and properties of solid and hazardous waste.
- 3) Students will become familiar with the history and the legal framework surrounding hazardous waste issues.
- 4) Students will learn about hazardous waste characteristics, pathways in the environment, and toxicological impacts.
- 5) Students will understand how quantitative risk assessments are conducted for toxic substances and their adverse effects on living organisms and the environment, and the limitations of the results of these analyses.
- 6) Students will understand about the importance of environmental audits and pollution prevention programs as effective waste management practices.
- 7) Students will be able to identify the most common techniques to prevent, minimize, recycle, dispose and treat waste and their application on site remediation.
- 8) Students will apply creativity and knowledge to design systems for site remediation that meets realistic constraints such as economics, environmental, social, regulatory, health & safety, constructability, and sustainability.

Required field trip: Local hazardous waste remediation site

Homework: There will a number of homework assignments during the semester, and a due date is provided with each. Homework is due on the due date at the BEGINNING of class. Penalties for homework handed in late are:

- One day or less: 30% off
- 2 to 3 days: 50% off.
- More than 3 days: no credit.

Grading:	400-level	500-level
Midterm exams	25%, 25%	20%, 20%
Final exam	25%	25%
Homework	15%	10%
In class participation	10%	10%
Term paper/presentation		15%

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Exam Guidelines and Policy

Exam Resources: A **single** 8.5 inch by 11.0 inch sheet of paper may be brought to each exam with any equations, information, worked problems, etc. the student feels useful. The paper may be typed or handwritten, and both sides may be used. One or more sheets of conversion factors, constants, numerical values, etc. will be handed out with the test. These will **NOT** include equations.

Late Exams: No make-up exams will be given except by prior arrangement with the instructor, at least, one week before the scheduled exam time.

The date and time of the final exam, along with links to the **Final Exam Regulations**, <https://www.registrar.arizona.edu/courses/final-examination-regulations-and-information>, and Final Exam Schedule, <http://www.registrar.arizona.edu/schedules/finals.htm>

IMPORTANT DATES AND DEADLINES

DATE	Exam or Date due
TBD	Selection of topic for term paper (only 500-level)
TBD	Exam # 1
TBD	Turn in list of literature citations for term paper (only 500-level)
TBD	Turn in outline term paper (only 500-level)
TBD	Exam # 2
TBD	Written term paper due (only 500-level)
TBD	Graduate student presentations
TBD	Final examination (Lec. 1 to end): Time TBD

PRELIMINARY COURSE SCHEDULE

Topics

- Course outline, policies, overview
 - Case histories of hazardous waste mismanagement
 - Hazardous waste laws and regulations
 - Toxic and hazardous substances: nomenclature and sources
 - Hazardous waste: properties and classification
 - Fate of hazardous substances in the environment:
 - (bio)sorption
 - volatilization
 - abiotic and biotic transformations
 - Hazardous waste toxicology
 - Hazardous waste risk assessment
 - Approaches to hazardous waste minimization, remediation, treatment and disposal
 - Hazardous waste prevention and minimization (Waste audits, life cycle assessment)
 - Landfill disposal
 - Hazardous waste solidification and immobilization
 - Bioremediation processes
 - Design of sorption processes: granular activated carbon
 - Volatilization design: Stripping
 - Advanced oxidation processes
 - Disposal of radioactive waste
 - In situ chemical oxidation (ISCO) processes
 - Reactive barrier walls for the remediation of groundwater
 - *Tour of contaminated site and remediation facilities*
-

INDIVIDUAL PROJECT (Only 500-level students)

Students must prepare a literature review on a particular hazardous pollutant (or class of pollutants) and a method commonly used for its remediation, treatment or disposal. Students should indicate their preferences not later than **February xx**. Please consult with the instructor on your decision. You will give an oral presentation on the topic to the class. In addition, you are required to prepare a term paper.

- You should review at least 8 articles from literature (preliminary selection of articles due on **Date TBD**).
- Outline of term paper due on **Date TBD** (one page listing the main topics to be addressed).
- The term paper must be submitted on **Date TBD**. **10-12 pages** (excluding references, cover page and table of contents). Any appropriate, clearly legible, typeface may be used of 12 point. Lines should be 1.5 spaced. The term paper will be organized as follows:

Cover page

Table of Contents

Abstract/Summary (maximum 1/2 page)

Introduction and background

Objectives: (objectives of your literature study)

Results (what is known from research papers on the topic, design/operation/application of the selected method)

Discussion (what are the potentials and limitations of the treatment system considered, what research still needs to be done)

Conclusions and recommendations

References

Appendices, if any (not to exceed 5 pages)

- Oral report presentation (May xx)
 1. Power Point presentation, 15 minutes
 2. Question/Answers session: 3-4 minutes

ADDITIONAL POLICIES, WARRANTIES AND DISCLAIMERS:

- 1) **Absence and Class Participation Policy.** Students are expected to attend lectures. The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>.
The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.
Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>
Students that fail to attend a field trip must submit a 5-page report on a topic assigned by the instructor. The report will be due no later than 7 days after the date when the field trip took place.
- 2) **Classroom Behavior Policy.** To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).
Please treat speakers with respect and in a professional manner. Please **do not arrive late to class** and give the speakers your attention (e.g. no texting, emailing, etc.)
- 3) Cell phones, pagers, and other electronic devices must be turned off before the start of class. If using such devices to take notes, please put switch to airplane mode.
- 4) **Accommodations for students with disabilities:** It is the University's goal that learning experiences be as accessible as possible. Students who need special accommodation or services should contact the Disability Resources Center, 1224 East Lowell Street, Tucson, AZ 85721, (520) 621-3268, FAX (520) 621-9423, email: uadrc@email.arizona.edu, <http://drc.arizona.edu/>. You must register and request that the Center or DRC send me official notification of your accommodations needs as soon as possible. Please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate. *The need for accommodations must be documented by the appropriate office.* Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.
- 5) **Code of Academic Integrity.** Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.
The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.
- 6) **Threatening Behavior Policy.** The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

- 7) **UA Nondiscrimination and Anti-harassment Policy.** The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

- 8) **Special materials required for the class:** none

- 9) **Confidentiality of Student Records**

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

- 10) **Subject to Change Statement:** The information contained in the syllabus (except grade and absence policies) may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.