GEOLOGY 657 **Spring 2006**
GEOLOGICAL ASPECTS OF HAZARDOUS WASTE DISPOSAL
(PROBLEMS IN WASTE DISPOSAL)

3 Hours Lecture, 3 Hours Credit

INSTRUCTOR: Dr. Joseph H. Rule, Associate Dean, College of Sciences
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CLASS HOURS: MW, 3:00-4:15 pm; OCNPS 202

OFFICE HOURS: Mon, 8:30-9:30 AM; Thurs, 9:30-10:30 AM; other hours by appointment.

COURSE TEXT: Testa, S.M. Geologic Aspects of Hazardous Waste Management

REFERENCES: A Library Reference Book List is attached. Both specific assignments and general reading are given for these books. Additional references and class handouts are provided.

COURSE STRUCTURE: Lectures by instructor with possible lecturers from outside. Class discussion and participation is expected. Students will prepare and present one talk to the class with an accompanying paper to be turned in.

GRADING:

Exam 1 -	20	Exam 2 -	20
Final Exam 3 -	30	Oral Presentation -	10
Written Paper -	10	Class Participation -	10

COURSE OBJECTIVES: Students will become familiar with major geologic and hydrogeologic principles important for waste management, techniques for subsurface chacterization, waste characterization including classification, sources and types of wastes. The major disposal methods (landfills and land disposal, underground injection, underground geologic repositories and ocean disposal) that affect geologic materials and ground water are discussed. Hazardous wastes (including nuclear) are given special attention. Site investigations, remediation practices, health protection and legal regulations are also discussed.

CLASS PRESENTATION: The class presentation will be on a specific topic (mutually chosen by the student and instructor). The presentation will be limited to 15 minutes with an additional 10 minutes for questions and discussions. Failure to observe these time limits will severely affect the grade for the presentation.

WRITTEN PAPER: This will be a concise written coverage of the material in the oral presentation. The paper should be a short (5-10 typed pages) report on a subject pertaining to the theme of the course. The topic and brief outline should be approved by the instructor prior to the writing of the manuscript. There should be an abstract, introduction, discussion, summary and conclusions and literature cited sections. You should include your own opinions where appropriate, especially in the summary. Make sure that the source of the information is clear to the reader, throughout the manuscript. Please use the Journal of Environmental Quality as your style reference.

PAPER NOTE: Paper selection and approval must be completed by the fourth week of classes , the class presentation given at the scheduled time and the written report must be handed to the instructor by the last day of classes. It is the responsibility of each student to meet these deadlines.

COURSE OUTLINE

1. Chapter 1 - Introduction

2. Chapter 2 - Regulatory Framework
   - EPA: Resource Conservation & Recovery Act (RCRA) ; EPA: CFR 40
   - EPA: Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
   - Sources and Types of Wastes (Handout)
   - Conducting a Site Investigation - Class Project (Handouts)

3. Chapter 3 - Geologic Principles
   - Porosity, Permeability and Diagenesis
   - Sedimentary sequences
   - Structural style and framework

4. Chapter 4 - Hydrogeologic Principles
   - Flux equation
   - Saturated systems
   - Unsaturated systems

5. Chapter 5 - Subsurface Characterization
   - Subsurface exploration
   - Classification of subsurface materials
   - Soil vapor monitoring
   - Boring logs/Well construction details

6. Chapter 6 - Geophysical Applications
   - Subsurface geophysicsl techniques
   - Downhole geophysical techniques

7. Chapter 7 - Waste Characterization
   - Soil as a hazardous waste
   - Groundwater as a hazardous waste
   - Crude oil
   - Debris rule/Declassification

8. Chapter 8 - Subsurface Processes
   - Physical processes
   - Biological processes
   - Chemical processes

9. Chapter 9 - Nonaqueous Phase Liquids Properties
   - Light nonaqueous phase liquids
   - Dense nonaqueous phase liquids

10. Chapter 10 - Landfill Disposal
    - Landfills - Design and construction
      - Sanitary landfill
      - Hazardous waste ("secure") landfill
    - Land Disposal: Sludges, oily wastes, ash, leachates (Handout)
    - Problems and solutions

11. Chapter 11 - Underground Injection
    - Classes of injection wells
    - Siting criteria
    - Hydrogeologic considerations
    - Design criteria
    - Reporting and monitoring

12. Chapter 12 - Underground Geologic Repositories
    - High level nuclear waste - Characteristics, properties, special problems (Handout)
    - Host rock types
    - Design considerations
    - Low level wastes (Handout)

13. Chapter 13 – Ocean Disposal
    - Types of ocean waste
    - The ocean environment
    - Ocean processes
    - Geologic considerations

GEOLOGY 657 REFERENCE BOOK LIST

The following is a list of books that are on Overnight Reserve (24 hours only) in the Library.

CALL NUMBER	AUTHOR	TITLE
TD878.Y66	Yong, et.al.	Principles of Contaminant Transport in Soils
TD795.7.W44	Weiss, S.	Sanitary Landfill Technology
TD730.N45	Nemerow, N.	Industrial Water Pollution
TD791.H27	Wilson, D. (ed)	Handbook of Solid Waste Management
EP1.17:183C	USEPA	Hazardous Waste Management Issues Pertinent to Section 3004 of RCRA
TD896.S92	von Zyl, et al (eds)	Geotechnical and Geohydrological Aspects of Waste Management
D796.7.L36	Loehr & Malina (eds)	Land Treatment. A Hazardous Waste Management Alternative
TD795.7.L56	Haxo et al	Liner Materials for Hazardous and Toxic Wastes and Municipal Solid Waste Leachate
TD811.5.E47	Ehrenfeld & Bass	Evaluation of Remedial Action
TD811.5.S57	Sittig	Landfill Disposal of Hazardous Waste
TD811.5.I53	Cheremisinoff, et al	Industrial and Hazardous Wastes
TC187.D7	Kester, D.M.	Dredged-Material Disposal in the Ocean
TD811.5.R64	Wagner, K. et al	Remedial Action Technology for Waste Disposal Sites
TD898.2.C44	Chapman, N.A.	Geological Disposal of Nuclear Waste
TD811.5.P75	Levine & Martin	Protecting Personnel and Hazardous Waste Sites
EP1.17.765	USEPA	Hazardous Waste. A Guide for Obtaining Permits and Authorization for State Programs