

ENV 4212 – Radioactive Waste Management (3 credits), Elective Course, Spring 2006

Description: This course is a review of the field of radioactive waste management. It defines the various categories of radioactive waste and provides information on sources, volumes, treatment/storage/disposal methods, applicable regulations, and environmental and economic considerations. Emphasis is placed on the technical problems yet to be resolved and current research in the nuclear waste area. The critical topics of waste minimization, decontamination and decommissioning of nuclear facilities, and transportation of radioactive wastes are also addressed.

Course Objectives: The objectives of this course are to provide the student with an understanding of radioactive waste management requirements and practices, to make him/her aware of social, economic, and environmental concerns as well as technical research needs, and to introduce him/her to sources of information not generally consulted by engineering students but important in radioactive waste management.

ABET Program Educational Objectives / Professional Components Supported by Course:

1. Graduates will have successful careers in Nuclear Engineering and related disciplines.
2. Graduates will pursue advanced degrees or continuing education.
3. Graduates will communicate effectively and work collaboratively in Nuclear Engineering and related disciplines.
4. Graduates will use the knowledge and skills obtained in their undergraduate education to practice high ethical and professional standards in Nuclear Engineering and related disciplines

Program Outcomes Supported by Course:

- Outcome a: An ability to apply knowledge of mathematics, science, and engineering for problem solving in engineering.
- Outcome d: An ability to function on multi-disciplinary skills teams.
- Outcome f: An understanding of professional, ethical and regulatory responsibility in engineering practice.
- Outcome g: An ability to communicate effectively, using both oral and written presentations, in engineering practice.
- Outcome h: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- Outcome i: A recognition of the need for life-long learning and the ability to adapt this to engineering practice.
- Outcome j: A knowledge of contemporary issues as they relate to professional engineering practice.
- Outcome l: An ability to apply advanced mathematics, science, atomic and nuclear physics and engineering to nuclear and radiological systems and processes.
- Outcome n: An ability to work professionally in one or more areas of: nuclear power reactors, nuclear instrumentation and measurement, radiation protection and shielding, and radiation sources and applications

Text: Radioactive Waste Management, 2nd Edition, by Saling and Fentiman

Grades: Assignments 1,2,3: 15 % ; 3 exams 60 % ; Term Project 20 % ; Class Participation 5 %

Course Outline

Week 1 (Text: Chapter 2)

Course overview; sources of information on radioactive waste. **Assignment 1 made**
Review of some fundamentals: radioactive decay, half-life, background radiation, units, activity.
Review of some fundamentals: radiation monitoring, protection, and shielding. **Assignment 2 made**

Week 2 (Text: Chapters 1 & 2.4-2.5)

Pathway analysis
Nuclear fuel cycle and uses of radioactive materials - **Assignment 1 due.**

Week 3 (Text: Chapters 1)

Student Presentations and Nuclear fuel cycle and uses of radioactive materials (con't)

Categories of radioactive waste; radioactive wastes in the news; requirements for term project.

Week 4 (Text Chapters 3 & 4)

Spent nuclear fuel - volumes, storage, treatment options. **Assignment 2 due.**

High-level waste - sources, volumes, storage, treatment..

SNF and HLW disposal program in the U.S. **Assignment 3 made.**

Week 5 (Text: Chapters 5)

Regulations governing SNF and HLW disposal; societal, environmental, economic considerations. **Choose teams for term project**

HLW treatment and disposal in other countries; current research topics.

Exam: Radiation fundamentals, fuel cycle, SNF, HLW

Week 6 (Text: Chapter 7)

Low-level waste - definition, sources, current and projected volumes; treatment and storage options-

Regulations governing LLW; societal, environmental, economic considerations; State compacts

Week 7 (Text: Chapter 8, and 9)

LLW disposal program in U.S. and other countries; minimization; current research. **Assignment 3 due**

Mill tailings and mixed waste - **One-page summary of project topic due**

Week 8 (Text: Chapter 9)

Review for second Exam

Exam: (Covers LLW, mill tailings, mixed waste)

Discussion of project and written and oral reports

Week 9

Students work on term project – Provide detailed outline of project report

Week 10 (Text: Chapter 10)

DOE weapons complex; need for environmental restoration, extent of the contamination

Environmental restoration - applicable regulations, cognizant agencies, current plans, timetable, budget, current research

Week 11 (Chapter 6)

Environmental restoration - applicable regulations, cognizant agencies, current plans, timetable, budget, current research

Transuranic Wastes

Risk assessment as applied to cleanup of DOE sites

Week 12 (Chapter 11 &12)

Decontamination and decommissioning; and Transportation of radioactive waste

Week 13 (No assignment in text)

Review for Exam

Exam: Transuranic wastes, DOE weapons complex, environmental restoration, D&D, transportation

Student Presentations

Weeks 14 and 15: (No assignment in text) Student Presentations and Written Report due