

Nuclear, Plasma, and Radiological Engineering 442
Radioactive Waste Management
Spring 2023
University of Illinois at Urbana-Champaign

3:30 to 4:50 pm. Tuesdays and Thursdays in 3018 Campus Instructional Facility

Instructor
Prof. W. R. Roy
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Course description: 3 hours credit. Prerequisites MATH 231, PHYSICS 231 or 212.

Welcome! Climate change has resulted in a renaissance of the Nuclear Industry. One of the major barriers to nuclear energy, however, is the management of radioactive wastes. In this course, we will discuss:

How radioactivity impacts waste management:
- Background sources of radiation.
- Health impacts of radiation.
- Attenuation of radioactivity by solid matter.

Concepts borrowed from geology and chemistry:
- Geochemistry of radionuclides and hydrogeology.
- Uranium and thorium resources.

The various radioactive, hazardous and mixed wastes and how they are managed:
- Low-level radioactive wastes, used nuclear fuel, U.S. DOE legacy wastes, decommissioning wastes, geological repositories, waste package stability, transportation of radioactive materials, and radiological risk management.

International radioactive waste management
- France, Japan, Russia, and in 12 other countries.

And more!

Course Wiki Website

https://wiki.cites.illinois.edu/wiki/display/NPRE442sp12/Home

Course Textbook

Roy, W. R. 2021. Radioactive Waste Management in the 21st Century. World Scientific Publishing Company, Singapore, 298 p., ISBN 978-981-122-829-2.

Overall-Learning Objective

Connect a group of engineering- and science-oriented students with the current and future issues resulting from the management of radioactive, hazardous, and mixed wastes created by nuclear energy, research, medicine, industry, and by defense activities.

Approach

The emphasis of this course is on concepts and experiences gained from case studies. This approach is accomplished by exploring the history and current status of radioactive-waste disposal using information from various fields of science and engineering, such as chemistry, geology, waste-site design and operation, and risk assessment. Technical knowledge about how radioactive wastes are managed in both the United States and in other countries is also emphasized. The course will provide insights into what to expect during the next 30+ years for managing radioactive wastes.

Grading

Midterm Exam	100 points
Final Exam	100
8 Class Assignments	160
Total	360

Grading Scale

A+ (> 96.0%), A (93.0 - 95.9), A- (90.0 - 92.9), B+ (86.0 - 89.9), B (83.0 - 85.9), B- (80.0 - 82.9), C+ (76.0 - 79.9), C (73.0 - 75.9), C- (70.0 - 72.9), D+ (66.0 - 69.9), D (63.0 - 65.9), D- (60.0 - 62.9), F+ (56.0 - 59.9), F (53.0 - 55.9) and F- (< 52.9) of the total number of points.

About the instructor

Prof. Roy's principal area of expertise is the application of geology and chemistry to the study of waste management. His research also includes security preparedness, and decommissioning/environmental restoration of nuclear-energy facilities. He has made the "(Incomplete) List of Teachers Ranked as Excellent by their Students" 36 times. He has taught NPRE 442 fifteen times. In 2011 and 2018, he was presented with the American Nuclear Society "Students' Award for Excellence in Undergraduate Teaching." In 2017, 2020, 2021, 2022, and 2023, he was nominated for the College of Engineering Rose Award for Teaching Excellence. In 2018, NPRE named him "Teacher of the Year." He was appointed to the Academy of Excellence in Engineering Education in 2020. In 2022, he was also nominated for the Campus Award for Excellence in Graduate Teaching. In 2022, he gave the lecture "Teaching Radioactive Waste Management in Illinois, Denver, and Sweden: Lessons Learned" at a Nuclear Waste Educators' Workshop.

Prof. Roy also teaches NPRE/GLBL 481, *Writing on Technology and Security,* and NPRE 498 D, *Decommissioning Nuclear Facilities*. He is a former Lecturer and Co-organizer for the Royal Institute of Technology in Sweden for SH262V, *Geological Storage of Nuclear Spent Fuel.* He also teaches two graduate-level, on-line courses for the University of Denver: EPM 4465, *Environmental Restoration and Waste Management,* and SMGT 4220, *Hazardous and Radiological Materials Preparedness.* He is a faculty member of the Program in Arms Control & Domestic and International Security (ACDIS).

Prof. Roy served as an Editor and Associate Editor of the *Journal of Environmental Quality*, a lecturer for a NATO Advanced Study Institute in Italy, and a Peer Review Panelist for the U.S. Environmental Protection Agency. He has also served on the Editorial Boards of the *Journal of Hazardous Wastes* and the *Soil Science Society of America Journal*. He is currently an Editor for the *Journal of Nuclear Energy Science and Power Generation Technology*.

He has also been a consultant for various private, state, and federal agencies such as Life Systems, Inc. and the U.S. Department of Justice. He is currently a Geochemist for the Electric Power Research Institute (EPRI). For EPRI, he conducted research on radionuclides in coal combustion by-products, and on dissolved radionuclides in groundwater. He was also a member of the NPRE Reactor Safety Committee. He has represented NPRE on the Radiation and Laser Safety Committee (UIUC). He is a member of the American Nuclear Society (Fuel Cycle and Waste Management and the Decommissioning and Environmental Sciences Divisions). He is on the Executive Committee of the Decommissioning and Environmental Sciences Division. Office hours (117 Talbot Laboratory) often before class or call/e-mail for an appointment.